Concrete

Vol. 21 *Detroit, December, 1922* *No. 6*

Twenty Years of Concrete Promotion

THE Portland Cement Association has just celebrated its twentieth anniversary with a round of "reminiscing." Looking back twenty years over the history of cement, the manufacturers have a good deal to think about—the things that *are* that *weren't;* roads, for instance, about 75,000,000 sq. yds. put under contract in 1922, using approximately a fifth of all the cement produced—and we are only now beginning to learn how to design a concrete road as other works are designed, to meet certain structural demands.

The Portland Cement Association has done good promotional work—good because it has been based chiefly upon a sound principle, the principle that knowledge of how to do a job right is the best forerunner for the work of the salesman. In the next twenty years a great deal more will be done. The cement manufacturers will give us better cement—cement that will harden quickly—cement conforming to more finely drawn standards.

The cement producers haven't had uniformly easy sledding. Fuel, transportation and unwise competition have given them many bad years. A good many of them have lately had to go into court to defend themselves on charges of illegal restraint of trade. Guilty or innocent, the Government certainly didn't make out a strong case. A jury was so swamped with technical information it couldn't decide their guilt or innocence—and a new trial is postponed, leaving a very unsatisfactory situation.

The ultimate consumer pays too much for many things. There are more things wrong with American distribution than are wrong with producers, wholesalers, or retailers. If cement costs too much, and it propably does, then we are being robbed blind in other quarters. With a few possible exceptions, the cement producers aren't getting disgustingly rich, but the future holds possibilities for economy in a large way—not by creating more competition but by eliminating the weak sisters, and by increased and uninterrupted production. The consumer is restless; he knows something is wrong; he doesn't know exactly what it is, but he sometimes gets worked up to the pitch of wanting to send somebody to jail. What we need to lower costs is not less profits, but less waste. In that direction lies production and distribution progress in the next twenty years. The cement manufacturers know this. They are doing something about it, and will probably do more, because a good many of them are of the progressive sort. In the meantime there is this note of cheer for the cement user in the address of John R. Morron, president of the Atlas Portland Cement Co., at the Portland Cement Association's annual banquet. Mr. Morron showed from government statistics that:

"A bushel of wheat, a bushel of corn, a ton of hay, a pound of butter, a barrel of flour, a tierce of lard, a side of bacon, a barrel of salt, a pound of sugar, a bushel of potatoes, a bale of cotton, a ton of coal, a ton of copper, a ton of steel rails, a thousand bricks, a thousand feet of soft or hardwood lumber, or the wages of a laboring man, in July, 1922, would purchase from 30% to 250% more cement at the plants than in 1892—30 years ago."

Mr. Morron also showed that the raw material, bituminous coal (of which thousands of tons per day are used) delivered at the Atlas' largest plant during three months of 1922, cost more per ton than his company received for the highly manufactured product in which the coal was used.

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The Fountain of Time

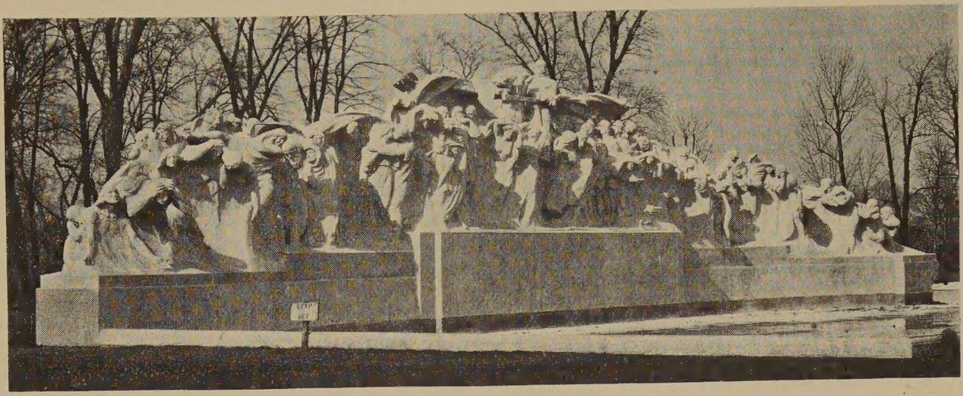
LORADO TAFT'S Fountain of Time, described and illustrated on other pages, serves to remind us, through the skill of John J. Earley, that, as often emphasized before, the beauty of "cement work" is not the beauty of concrete work. Cement work as exemplified in some kinds of surfaces, especially plastered surfaces, where an interesting result is obtained by the manipulation of the mix, is limited by that manipulation and the color values are limited to the color values of cement.

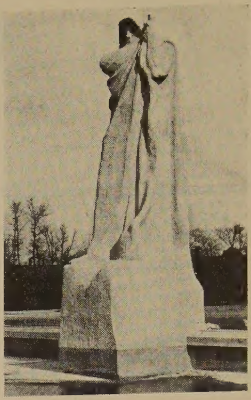
Introduce into the mix a careful blending of colorful aggregate; expose that aggregate by the removal of the surface film, and the result is something entirely different. The aggregate not only determines the color and dominates the whole effect, but gives, under skillful workmanship, that texture in the surface, which reflects or absorbs the light as the case may be, and brings concrete into an entirely new realm of service to art.

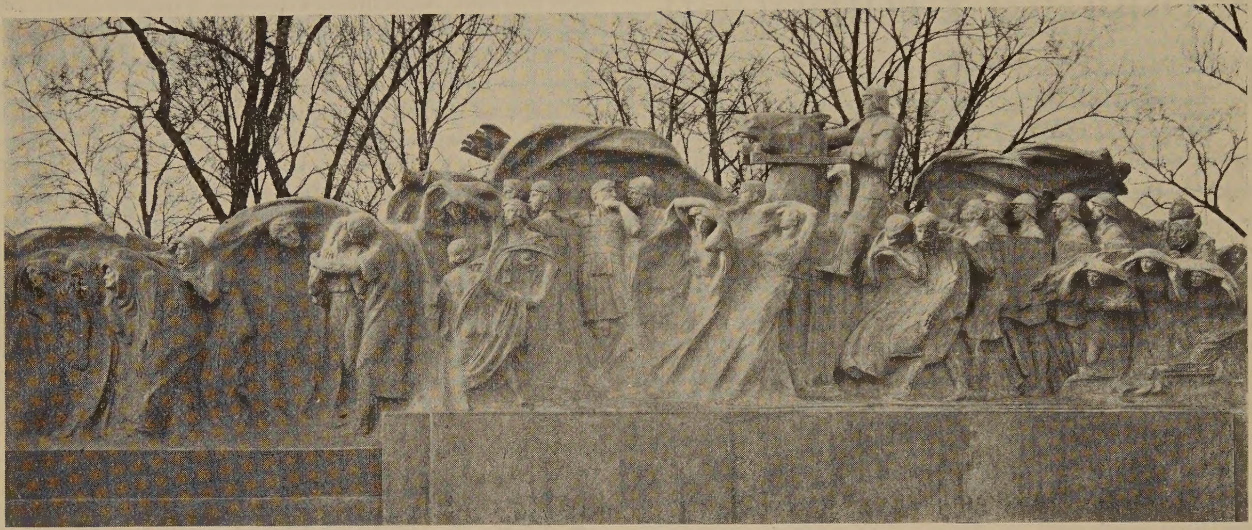
* * *

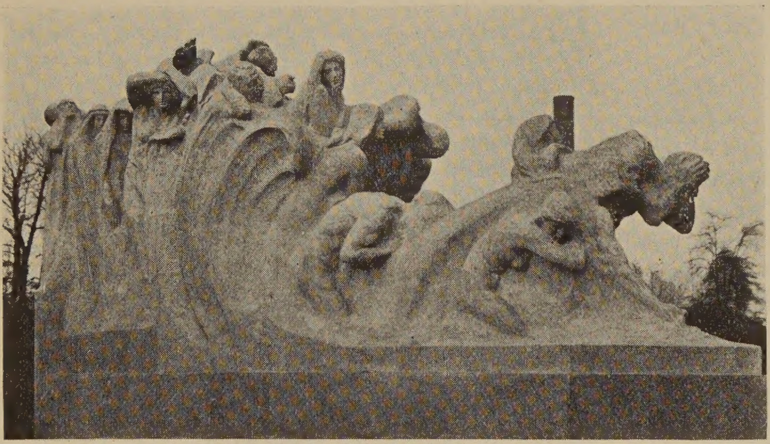
Houses and Roads

THE Annual Housebuilding Number of CONCRETE, become an institution in clearing up the problems and explanations of detailed practices and results in the application of concrete to the uses of dwelling construction, will appear in February, instead of January. The annual presentation of house building progress and the annual review of roadbuilding practice, appearing for a number of years in January and February, respectively—have changed places. Roads will have special consideration in January—Houses in February.









"Time goes, you say? Ah, no.
Alas, Time stays; we go."

Lorado Taft's Massive Group—More Than Eighty Individual Figures, in a Series of Sculptured Waves, Pass in Review Before the Immortal Figure of Time—Done in Concrete by John J. Earley

Lorado Taft's *Fountain of Time* Done in Concrete by John J. Earley

A Triumph in Application of Concrete to the Uses of Art

The accompanying illustrations (opposite page) show the Fountain of Time, Chicago, Lorado Taft, sculptor, as done in concrete by John J. Earley, Washington sculptor and exponent of the Earley method in the application of concrete to art and architecture.

The fountain was unveiled the latter part of November. It has unusual interest from the standpoint of civic development, as a work of art, as an example of a new triumph of the material concrete.

The use of concrete resulted in a saving of more than $200,000. It must be regarded as a distinct triumph for the material, not only from the standpoint of economy, but because the artistic results are immensely pleasing to the sculptor. Mr. Taft proclaims Mr. Earley as true an artist as he has ever met and his work on the Fountain of Time an eminent success, being superior in color and texture to chiselled marble.

The fountain is 120 ft. long, as is the sculptored group back of it. In front of the fountain basin is the figure of Time, a new conception of Time as an immovable crag of rock, given human form, watching the procession of humanity across the pool that lies before it.

The work was originally executed by Lorado Taft in plaster and its final execution in marble, at a total cost of $300,000, was at first considered the only method for its lasting reproduction. This was true until Mr. Taft learned of the technic in the application of concrete by the Earley process. He immediately got in touch with Mr. Earley and Mr. Earley became extremely interested in the problem. The actual work of reproduction was done in about two and a half months.

A massive concrete base was constructed and upon it built up an inner falsework. The outlines of this falsework were very carefully worked out to keep six inches away from the extreme outer surface as finished, in order that the finished group might have a total thickness of concrete of six inches.

Ilustrations show various steps in the construction. At intervals spaces were left in the falsework for connecting or bulkhead walls from one side to the other. Over the falsework was placed a metal fabric and on this plastered a weak porous base of portland cement and sand. It was made porous in order to take the excess water out of the structural mixture in placing and give the strongest possible result. Following these preliminary steps, steel was placed wherever required for reinforcement.

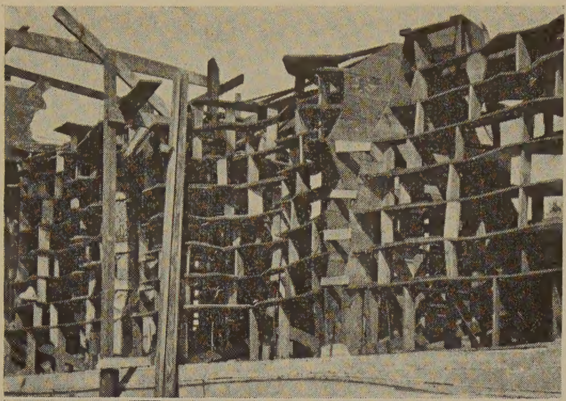
In the meantime plaster piece molds were built up around the plaster structure executed by the sculptor. A great deal of care was necessary in marking level points on the plaster piece molds as they were constructed and in keeping cross sectional dimensions absolutely true, this due to the fact that it was not the intention to do all the concreting in continuous operation. The plaster piece molds were removed and set up on the concrete base around the falsework and the large group was cast in sections in place. Painstaking workmanship resulted in almost complete obliteration of the lines of juncture of the various sections of the work. Some of the pictures show a section of the fountain from which the plaster piece molds have been removed, in addition to another section where the casting is not complete. When the concrete was hard, the plaster piece molds were removed and the surface washed down with acid.

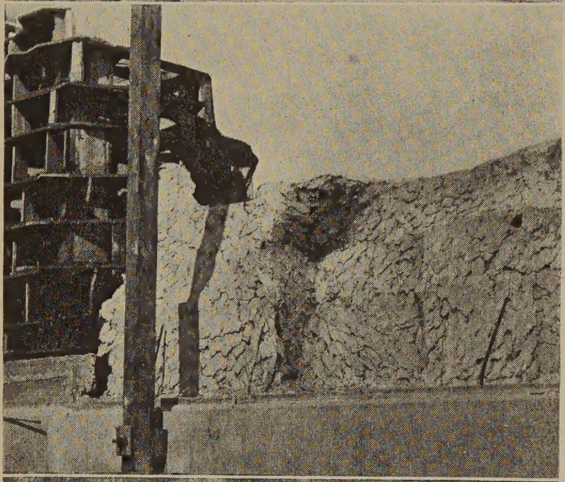
The concrete was made with Potomac River gravel, a material with which Mr. Earley has done a great deal of work in Washington. It is in beautiful yellow, buff and brown colors, and the careful grading, with surface coloring values in mind, which Mr. Earley does at his Washington plant, gives the final surface in which the percentage of cement visible is at a minimum. The aggregate is of a size that passes through a 3/8 in. mesh. A great deal of Mr. Earley's technic lies in the grading and final proportions of themix. So carefully have his formulas been worked out, that he has been able to do combination construction where concrete cast in place, concrete applied as stucco and concrete in precast units (in each case made with the same proportions of material) meet in one surface of the finished work, without leaving any difference in surface to mark the end of one part of the work and the beginning of the other.

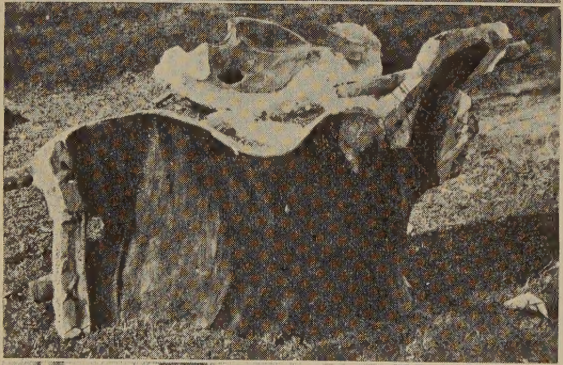
An examination of an accompanying illustration showing a close-up about 3/4 size of the surface texture of the Fountain of Time, may cause some marvelling that such a textured surface would give the delicacy of line which has so pleased Mr. Taft.

The result is achieved by Mr. Earley in a recognition of a fact which has escaped a great many workers in ornamental concrete. When they produce a surface, they do so with the thought of the object about three feet from the eyes, and as a single unit rather than as a part of a structure which is generally viewed from a distance. It is in this texture that the richness of coloring and good lighting are made possible. CONCRETE is informed that as compared with a total cost of $300,000 for the Fountain of Time done in marble, Mr. Earley's work was done for $45,000.

The Fountain of Time is a fragment of a comprehensive scheme for the decoration of the Chicago Midway—a parkway reminiscent of the Worlds Fair of 1893. It has been unveiled and formally presented to the South Park Commissioners for Washington Park. Mr. Taft's







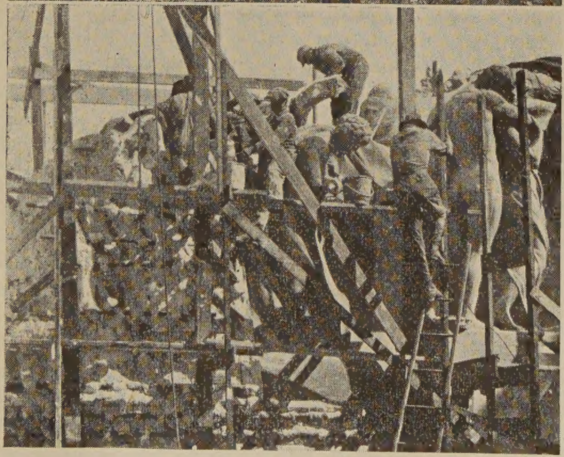


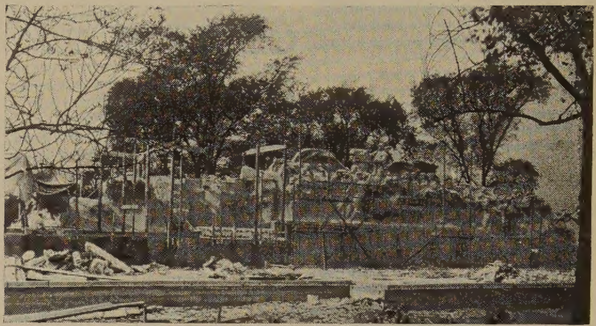
FIG. 1—INNER FALSEWORK USED TO SUPPORT STEEL FABRIC AND REINFORCING

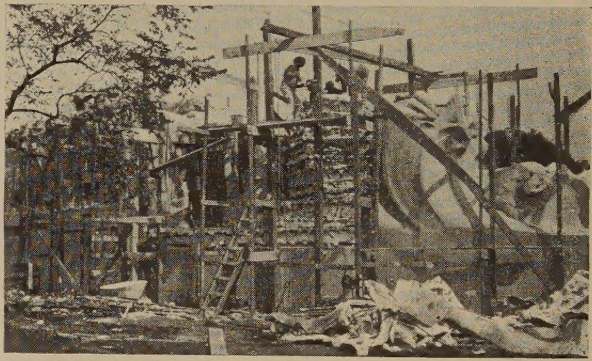
FIG. 2—PART OF STEEL FABRIC ON FALSEWORK PLASTERED WITH POROUS MIX TO MAKE INNER FORM

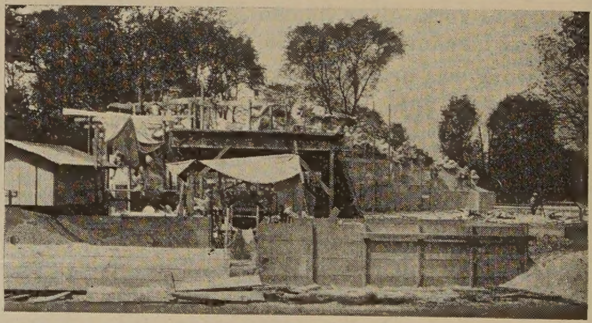
FIG. 3—A SECTION OF PLASTER PIECE MOLD

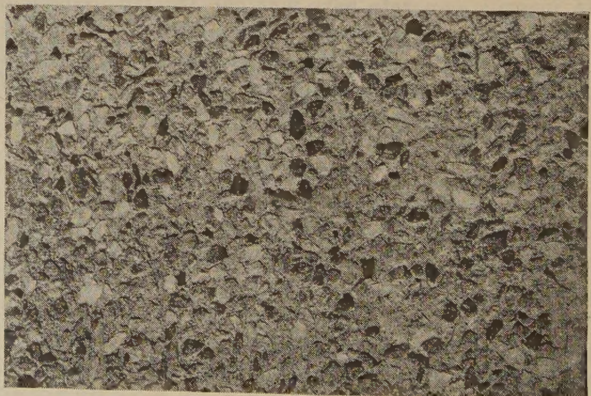
FIG. 4—THE FIGURES OF THE WORKMEN SETTING UP PLASTER PIECE MOLDS AND PLACING CONCRETE ARE HERE CONFUSED WITH SOME OF THE FIGURES OF THE SCULPTURED GROUP

plan presupposes a straight and formal canal which will run through the existing depressions of the Midway Boulevard. The canal would be spanned by three bridges of monumental design, to be dedicated to the three great ideals of the race, and to be called the bridges of the Sciences, of the Arts and of the Religions. Along the roadways, some distance back from either side of the canal, would stand statues of the world's greatest idealists, ranged at half block intervals and treated as architectural notes, connecting the bridges with fountains and uniting the various features of the decorative scheme.









FIGS. 5 AND 6—PROGRESS VIEWS IN CONSTRUCTION OF FOUNTAIN GROUP

FIG. 7—MR. EARLEY'S CONCRETING PLANT

FIG. 8—CLOSE-UP ABOUT ¾ NATURAL SIZE OF FINISHED SURFACE

At either end of the Midway, heading the canal, would be a large fountain; that at the eastern end being the Fountain of Creation or of Evolution, and at the western end the Fountain of Time. It is this latter fountain that has been completed for the committee in charge of the Ferguson Fund.

The Fountain of Creation would face westward, just west of the Illinois Central viaduct. This fountain makes use of the old classic myth of Deucalion, the Noah of Greek legend. Deucalion and his wife Pyrrha, being the only mortals saved by Zeus after the nine days flood, stepped out from their frail boat to the top of Mount Parnassus, and consulted a convenient oracle as to the best way of restoring the human race. They were told to cover their heads and throw the bones of their mother behind them, and Pyrrha divined that these bones were the stones of mother earth. Mr. Taft will show the moment when these stones, thus cast from the Titans' hand, are changing into men and women, rising out of the clod and flood and fog into life and light. The composition begins with creatures half-formed, vague, prostrate, blindly emerging from the shapeless rock; continues at a higher level with figures fully developed and almost erect, but still groping in darkness, struggling, wondering; and reaches its climax with a group, at the summit, of beings complete and glorious, saluting the dawn.

The Fountain of Time shows the human procession (more than eighty figures of men, women and children) passing in review before the great immovable figure of Time. Father Time is represented by a rugged, crag-like figure, reviewing a throng of hurrying people, the treatment being suggested by the couplet:

Time goes, you say? Ah, no
Alas time stays; we go.

The procession of hurrying figures viewed by Father Time is of people indistinct, but all hurrying and crowding towards a goal they cannot see. A warrior on horseback, flanked by banners and dancing figures, forms the center of the composition, which fades off at the ends into creeping infancy or the bent and withered figures of age. The procession seems to rise from a great jet of water on one side and sink from sight at the other; Time meanwhile standing firm and immovable. There is a suggestion of joyous onward movement in this procession and of the splendor and pageantry which life has achieved since that first great day of creation, which the other fountain celebrates.

Mr. Taft wrote the following before he made the first sketch for the Fountain of Time:

A vagrant line or two of Austin Dobson's once made a great impression upon me, says the poet:

"Time goes, you say? Ah, no
Alas time stays; we go."

The words brought before me a picture which speedily transformed fancy into a colossal work of sculpture. I saw the mighty crag-like figure of time, mantled like one of Sargent's prophets, leaning upon his staff, his chin upon his hand, and watching with cynical, inscrutable gaze the endless march of humanity—a majestic relief of marble I saw it, swinging in a wide circle around the form of the lone sentinel and made up of the shapes of hurrying men and women and children in endless procession, ever impelled by the winds of destiny in the inexorable lock-step of the ages. Theirs the fateful forward movement which has not ceased since time began. But in that crowded concourse, how few detach themselves from the greyness of the dusky caravan! How few there are who even lift their heads! Here an over-taxed body falls—and a place is vacant for a moment; there a strong man turns to the silent, shrouded reviewer and with lifted arms utters the cry of the old-time gladiators: "Hail Caesar, we who go to our death salute thee"—and presses forward.

It is more than a decade since Mr. Taft first exhibited a small model which was to be part of the larger sculptural scheme of decoration for the Midway in the vicinity of the University of Chicago. Under the auspices of the Ferguson Fund for sculpture he was given an opportunity to execute the "Fountain of Time" on a colossal scale in plaster, the work taking a period of years. Now, after another lapse of time, the gigantic group is given the public in a lasting memorial as a result of the development of a suitable technique in concrete by another sculptor, Mr. Earley.

Measurement of Concrete and Estimating Its Cost

Leslie H. Allen has been made temporary chairman of a group meeting to be called by the Board of Directors of the American Concrete Institute, for some time during the Institute convention (Cincinnati, January 22-25), to consider Measurement of Concrete and Estimating Its Cost. The Institute *News Letter* of November 22 carries the following from Mr. Allen:

Members of the American Concrete Institute:

Do you ever run into difficulties in the adjustment of unit priced contracts or argue as to how the work should be measured? Do disputes arise as to whether pipes passing through concrete should be deducted from the volume of concrete? If it costs more to bed a small pipe than the cost of the concrete it displaces, should you be penalized by deducting the volume it occupies?

How do you measure form work, by the square foot or the board foot? Do you ever find that the quantity of lumber you estimated differs considerably from the quantity that the superintendent says he had to use on the job? If you are a consulting engineer, how do you adjust this?

How do you estimate laps in reinforcement? Do you add a percentage for laps or do you figure accurately the amount of lap needed for bond or for negative moment?

Some years ago the American Concrete Institute appointed a committee to formulate rules for the measurement of concrete. A final report was adopted in 1916 for the guidance of its members. It is about time that we looked this over to find out how these rules have worked out in practice. It is very likely that some of them should be revised in order to conform with present practice in the engineering and contracting field.

With this in view, the Board of Directors is calling a meeting of consulting engineers, municipal engineers and contracting engineers to discuss this subject in its bearing on the pionts mentioned above. Many of the leading authors and estimators for leading contractors are expected to take part in the meeting, and a very interesting and illuminating discussion is sure to ensue.

If the need for it appears evident, a new committee may be then appointed to review the old rules of measuremnt and to draw up a new report on measurement and estimating of concrete work for further consideration.

The measurement of concrete work is closely wrapped up with the question of estimating its cost, and in connection with this meeting to consider methods of measurement, it will be advisable to discuss the principles of estimating concrete costs in some details.

It is unfortunately true that through disregard for some of the fundamental principles of estimating, much of the concrete work done by contractors has proved unprofitable to them. We chould endeavor at this meeting to bring out these principles and to embody them in the new conclusions.

Yours faithfully,

Leslie H. Allen.

The Nominating Committee of the American Concrete Institute, consisting of Messrs. F. R. McMillan, J. H. Chubb, H. C. Turner, K. H. Talbot, and A. T. Goldbeck, reports the following nominations: for president, W. P. Anderson; vice-president, A. E. Lindau; treasurer, Harvey Whipple; director 3rd district, S. C. Hollister; director 4th district, J. C. Pearson; director 5th district, D. A. Abrams.

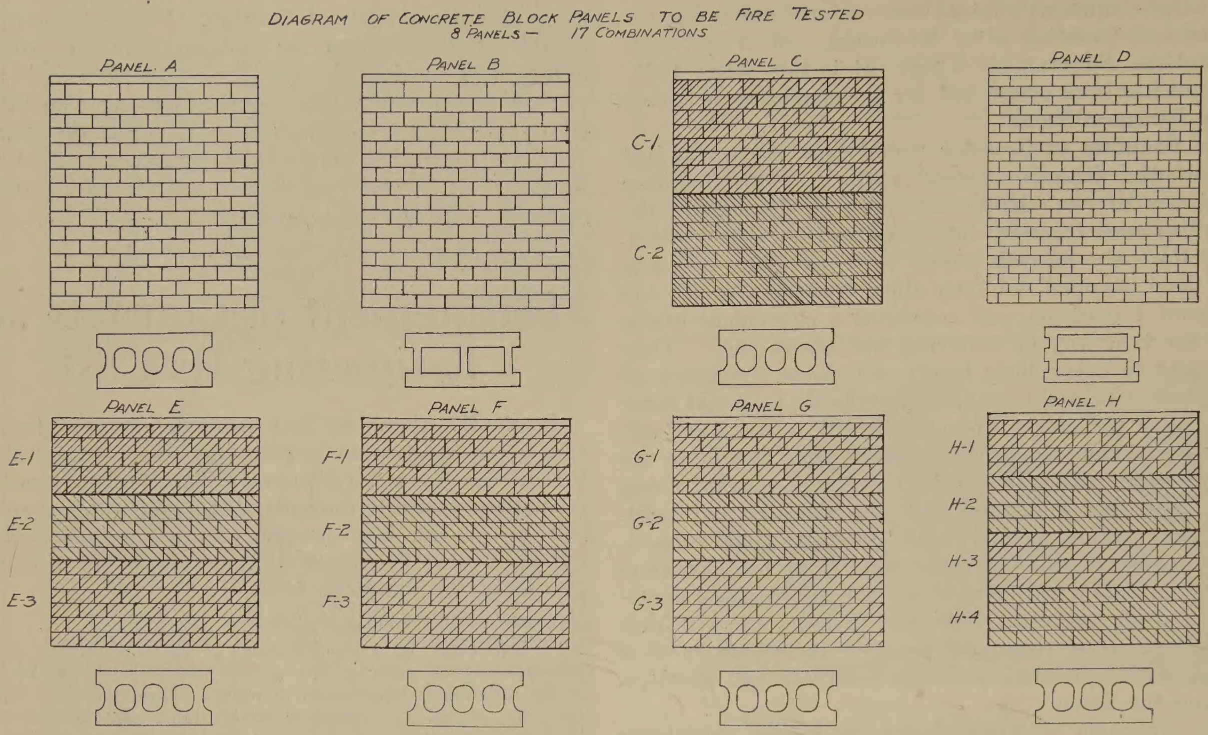


Fig. 1—Details of Panels of Concrete Block to Be Subjected to Fire Test at Underwriters' Laboratories, Chicago, for Committee P-1, American Concrete Institute

Panel A
112 full block.
16 half block.
Aggregate—Calcareous gravel.
Mix—1:5.
Consistency—Wet.
Curing—Steam.

Panel B
112 full block.
16 half block.
Same as A.

Panel C
C Aggregate—All to be calcareous gravel.
Consistency—Wet.
Curing—Steam.
C-1—56 full block.
8 half block.
Mix—1:8.
C-2—56 full block.
8 half block.
Mix—1:7

Panel D
Aggregate—Calcereous gravel.
288—full tile.
24—half tile.
Mix—1:3.
Consistency—Wet.
Curing—Steam.

Panel E
E—Aggregate—All to be calcareous gravel.
Mix—1:5. Curing—Steam.
E-1—35—full block. 5—half block.
Consistency—Dry.
E-2—35—full block. 5—half block.
Consistency—Damp.
E-3—42—full block. 6—half block.
Consistency—Wet.

Panel F
F—Aggregate—All to be calcareous gravel.
Mix—1:5. Curing—Air.
F-1—Same as E-1.
F-2—Same as E-2.
F-3—Same as E-3.

Panel G
G—Aggregate—All to be calcareous gravel.
Consistency—Wet. Curing—Steam
G-1 35—full block.
5—half block.
Mix 1:6.
G-2 35—full block.
5—half block.
Mix 1:4.
G-3 42—full block.
6—half block.
Mix 1:3.

Panel H
H—All to be 1:5 mix.
Consistency—Wet.
Curing—Steam.
H-1 28—full block.
4—half block.
Aggregate—Silicious sand and silicious gravel.
H-2 28—full block.
4 half block.
Aggregate—Calcareous sand and cinders.
H-3 28—full block.
4 half block.
Aggregate—Calcareous sand and slag.
H-4 28—full block.
4 half block.
Aggregate—Calcareous sand and crushed limestone.

Concrete Block Fire Tests

The illustration at the top of the this page shows the details of the eight concrete block panels to be subjected to fire tests under the program of Committee P-1, Fire Resistance of Concrete Building Units, American Concrete Institute, at the Underwriters' Laboratories, Chicago.

The results of these tests will be watched by concrete building unit manufacturers everywhere with a great deal of interest. They will be reported by Leslie Allen, chairman of Committee P-1, at the Institute Convention in Cincinnati, January 22 to 25. The block for all of the panels except panels B and D were made at the plant of the Hilker Co., at Granite City, Ill., under the supervision of M. J. O'Brien, representing the Underwriters' Laboratories; Stanton Walker, representing the Structural Materials Research Laboratory, and E. W. Dienhart, of the Portland Cement Association, representing the chairman of Committee P-1. These block have been shipped to Chicago and the panels are being laid up. The tests will probably be run Christmas week, when the work has attained an age of 28 days.

An outline of the tests is as follows:

In all of the tests, unless otherwise noted, the block tested is to be of the three oval core type, 8 in. by 8 in. by 16 in., to be of 1:5 mix, to be of a semi-dry mix having a consistency wet as possible, tamped with automatic tampers and to be hardened in the steam room. Except as otherwise specified, the aggregate is to be Elgin calcareous sand and pebbles grading 0 to ⅜ in.

Panels will be tested in Furnace No. 2. Panels to be mounted in a steel frame providing exposed face of panel approximately 10 by 11 ft., providing therefore 16 courses of block, each course containing approximately 7½ block.

Panel A will be as above described. This panel to be tested up to time of failure, but not to exceed 5 hours, the furnace temperature to be in accordance with the standard time temperature curve. At the end of five hours the panel to be withdrawn from the furnace and thereupon subjected to the standard fire hose stream test.

Panel B to have blocks with two square cores, otherwise to be similar in all respects to Panel A.

Panel C will have eight courses of block, 1:8 mix, and eight courses 1:7 mix. Block will be similar in all other respects to Panel A.

Panel D will be built of 5 by 8 by 12 concrete building tile, mix 1:3, curing and consistency like Panel A.

Panels B, C, and D will be exposed to the standard fire conditions in accordance with the standard time temperature curve for a minimum period of one hour, and for a maximum period of 5 hours. The actual time of exposure being determined at the time of test according to observations made of the conditions of the face of block exposed to fire and in accordance with the judgment of the test engineers as to the best period for discontinuing test in order to ascertain the exact relative performance.

It is not proposed to subject Panels B, C, and D to the fire hose stream test.

Panel E will be assembled as follows: Courses 1 to 5 from the top of the panel to be filled with block of a semi-dry consistency. Courses 6 to 10 to be filled with block made with a damp consistency. Courses 11 to 16 to be filled with block mixed as wet as possible. All of these block to be of a 1:5 mix, to have an aggregate of Elgin sand, with 0 to ⅜ in. pebples, hardened in the steam room, and to be of the three core oval type.

Panel F to be filled with block in the manner indicated for Panel E, the various details being the same except that all block has been hardened in air instead of the steam room.

Panel G is to be assembled similar to Panel E, except that the three sets of courses will be filled with block representing variations in mix as follows:

Courses 1 to 6: A mix of 1:3
Courses 7 to 11: A mix of 1:4
Courses 12 to 16: A mix of 1:6

Aggregate consisting of Elgin sand and pebbles graded 0 to ⅜ in.; consistency wet as possible and hardened in steam room.

Panel H to be run to determine the effect of fire on different kinds of aggregates, the panel to be filled with four groups of block each in four courses. For courses 1 to 4 block shall have an aggregate of Elgin sand and crushed limestone. For courses 5 to 8 block shall have an aggregate of Elgin sand and crushed air-cooled slag. For courses 9 to 12 the block shall have an aggregate of Elgin sand and cinders. For courses 13 to 16 the block shall have an aggregate of silicious sand and silicious gravel. (In all other tests an aggregate consisting of Elgin sand and pebbles grading 0 to ⅜ in. has been employed.) Panel H will be placed in the furnace first.

In panels C, E, F, G, and H, steel plates ⅜ in. thick and about 6 in. wide may be inserted in the mortar joints, between the courses where block differ as a precaution to avoid interference with performance in test of block in one set of courses in the event of unfavorable performance of block in adjacent courses.

Physical properties of representative samples from lots selected for the tests will be determined at the Lewis Institute Laboratories, in accordance with the adopted standard program of the American Concrete Institute for the test values in question, these being strength in compression, of specimens dried to constant weight, of specimens completely saturated, of specimens saturated and re-dried, of specimens which have been subjected to freezing and thawing, and later of samples removed from fire test panels subjected to the standard fire endurance test and to the fire and standard hose stream test, absorption test, and freezing and thawing test, also tests covering adhesion of mortar.

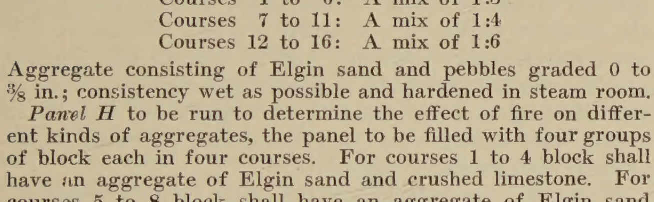


Fig. 2—Concrete Block for Fire Test at Hilker Plant, Granite City, Ill.

The money for these tests, which will cost in the neighborhood of $6,000, is not all subscribed; about $2,500 has been contributed by concrete products manufacturers through the Concrete Products Association, $215 has been raised by subscriptions by products manufacturers to the American Concrete Institute, and the Institute has further appropriated $500; $2,000 has been appropriated by the Portland Cement Association, which is also furnishing the labor and paying freight and miscellaneous expenses connected with the manufacture, delivery and laying up of the block.

To Discuss On-the-Job Problems

At two different sessions of the American Concrete Institute convention, Cincinnati, January 22-25, ample time will be set aside for broad consideration of many "on-the-job" subjects. There will be a "question box" for engineers and contractors, another for concrete products manufacturers. Some questions for the contractors and engineers have already been received and announced in an Institute *News Letter*. The name of the questioner will be held confidential, but the question will be assigned in advance to some one to answer, so it will have full consideration.

Here are a few sample questions already received:

How may cinders be used for roof fill most successfully to avoid expansion and displacement of parapet walls?

Does the saving which the use of slag entails warrant its use in Reinforced Concrete Buildings?

Which of the three following characteristics is most important in the making of good concrete: Strength, Density, or Impermeability? Give simple rules for attaining the desired results.

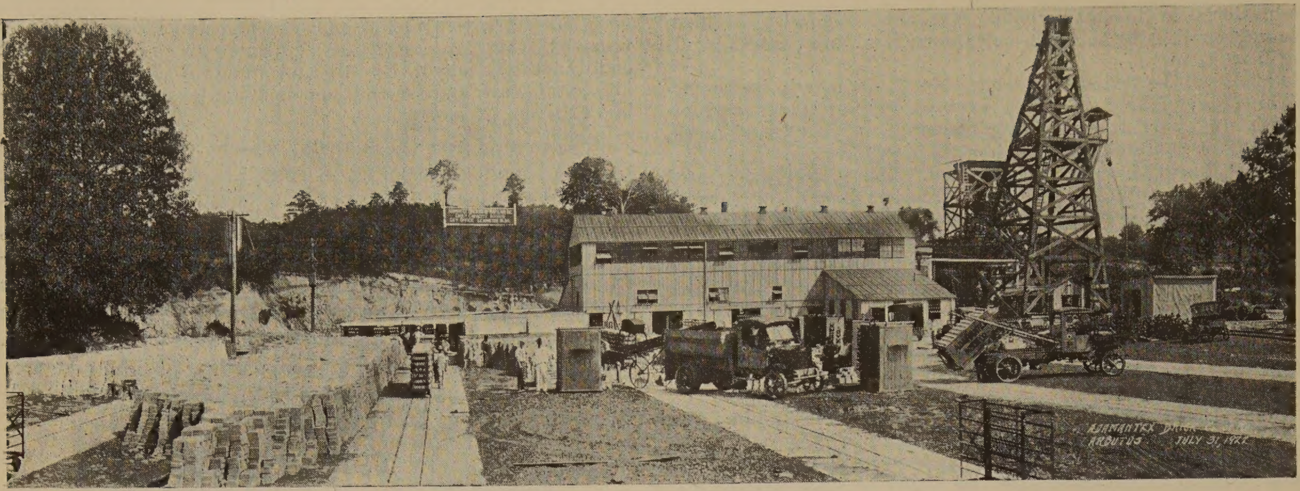
Provision is usually made in all building laws for the maximum ultimate loading to which the concrete may be subjected in compression after it has attained its full strength. We frequently have occasion to apply loading to concrete which is only a few days old, sometimes by means of hydraulic jacks and in other cases by direct loading. We are always confronting the assumption that we are overloading the fresh concrete. What would be considered the safe unit stress in compression on concrete 24 hours old under normal conditions of weather and materials, assuming a 1:2:4 mix? What expedients other than those customarily employed can be used to increase the value of concrete in compression under the above circumstances?

Is it better to install cement fill and finish before or after plastering is done?

What is the most economical method of handling concrete on a job considering quality as well as cost? This means from the time it leaves the mixer until it reaches its final destination in the building.

Destructive Agents

Under what conditions does concrete sometimes disintegrate and why? The American Concrete Institute's Committe E-6—Destructive Agents and Protective Treatments, M. M. Upson, chairman—has made an examination of the causes of failure which are evident in disintegration of concrete, under some conditions of exposure. The report of the committee of the convention in Cincinnati, January 22-25, will discuss somewhat in detail characteristic weaknesses of concrete and the apparent reasons therefor. This will be followed by setting forth practical rules to insure the permanency of concrete construction. Special attention will be given to the importance of securing concrete which is impermeable.



The Plant of the Adamantex Brick Co.

New Concrete Brick Plant at Baltimore

By Cloyd M. Chapman
Consulting Engineer, New York City

Concrete brick offer a promising means of relieving the present shortage of building material. They provide a suitable structural unit of high quality, which can be produced at a price comparable with its predecessor, clay brick. Raw materials for concrete brick are available in many localities in which suitable brick clay is not found. The present fuel situation also tends to encourage their manufacture, as the difficulty of securing fuel for the burning of clay brick steadily increases and its cost advances.

Concrete brick are no novelty—they have been manufactured and successfully used for many years. Hundreds of small plants throughout the country have been making concrete brick for a long time. The quality of the product is greatly superior to the run-of-kiln clay product. The full size, accurate shape, true edges and uniform color of properly made concrete brick are advantages quickly recognized by architects, users and owners.

Concrete brick lay so much more evenly in the wall that mortar joints are more uniform and the bedding and bonding more accurate than common clay brick, so that the strength of the wall is increased to a surprising degree. Common clay brick will develop in a wall or pier something like 20% to 25% of the compressive strength of the individual brick, while a concrete brick pier, laid up in the same manner and tested similarly will show a compressive strength of 50% or 60% or even a higher percentage of the average strength of the individual brick. These and other advantages have given the concrete brick industry an impetus that is now becoming quite evident.

The Adamantex Brick Co. of Maryland has a concrete brick plant in operation at Arbutus Station, about four miles out of Baltimore, on the main turnpike to Washington. This plant makes common brick of the natural grey color of cement mortar by the tamp process, and delivers them on the job in Baltimore in competition with common clay brick.

The demand for brick is so great and their product has so pleased the trade that the entire output of this plant for eighteen months has been sold in advance.

The sand deposit lies in a hill rising some 60 ft. above the level of the plant site, and covering an area of many acres. The sand varies considerably in different portions of the deposit, some sections being coarse and some containing beds of fine sand carrying an admixture of clay. To excavate the sand and deliver it at one operation to the elevated sand receiving hopper, a 1¼-yd. clam-shell bucket cableway is used.

The span of the main cable is 525 ft. and extends from a head tower 85 ft. tall to a 20-ft. tail tower located back on the hill. About two feet of top soil is stripped from the sand bank, and after a trench has been dug into the bank by means of the cableway, the sides are broken down and caved in to feed the bucket and also to mix the sand strata to produce a more homogeneous supply. The cableway bucket deposits the bank sand into an overhead hopper, from which it flows direct into the scrubber section of a rotating screen. To insure still more uniform raw material, and to remove any surplus of clay content, the sand is passed through a washer of the rotating screen type into a separating box, from which the muddy water overflows and the sand is removed by a scraper conveyor.

From the separating box the sand is discharged directly into either of two sand bins, on the top of which the sand washing and screening outfit is located. Each of these sand bins holds one days supply of sand, so that by filling them alternately time is allowed for the water to drain off through the cinder bed and drain pipes located under these bins.

The sand is drawn from the storage bins through feed gates on to a belt conveyor along the sides of the bin, and delivered to the boot of a bucket elevator, discharging into an elevator scraper conveyor, which carries the sand through the plant and distributes it to the hoppers of the mixers. The arrangement provides that the hopper of the mixers be kept full of sand, but that any surplus of sand beyond that required is brought back by the return flight of the scraper conveyor.

The cement is received in box cars on track adjacent to the sand receiving end of the plant, and stored in the end of the building. The bags are emptied into a hopper feeding a bucket elevator, which discharges the cement into a screw conveyor, which in turn distributes it to the cement hoppers of the mixers. Any surplus of cement is returned to the elevator boot by a second screw conveyor located below and to one side of the feeding conveyor. By this arrangement of conveyors the feed of both cement and sand is assured to the mixers and the surplus to the starting point.

The mixers are of the continuous type, three in number, with reciprocating proportioning feeders on both sand and cement. The water supply, containing the accelerator and hardener, Brick flux, is piped to the mixers and controlled by two valves—one for close adjustment of the flow and one for shut-off. In order to maintain a constant head to insure uniform flow of the water, the supply is pumped to an elevated tank located just under the roof. This tank is provided with an overflow return pipe. By pumping a surplus of the water-hardener mixture the tank is always full and overflowing, and there is a constant head on the supply lines to the mixers.

The mixed mortar is discharged by the mixers, which are located on the second floor of the plant, direct into hoppers which feed the brick machines. Each mixer serves two storage hoppers and each storage hopper supplies two brick machines. The brick machines are in groups of four on the ground floor, with parallel tracks on each side of the group. The special rack cars on which the brick are carried while curing enter the plant near the presses and are loaded with 56 steel pallets, each carrying ten brick, making a total of 560 brick per car. All cars are numbered and each operator keeps a record of the cars he loads and is paid a bonus for the brick made over and above an established minimum. This bonus system has greatly increased the output per machine, and of course proportionately increased the earnings of the operators.

The loaded brick cars are run on a transfer car holding two brick cars and moved out of the main building to the curing rooms. These rooms are four in number and each has four tracks holding eleven cars, or 44 cars in each room. Rolling canvas curtains close in each end of the curing rooms, and a system of steam pipes and water sprays is provided, which is designed to give a forced circulation of the air in the room to insure uniform moistening, heating and hardening of the brick. The exhaust steam from the engine operating the sand cableway is used for curing.

By the use of Brick flux for accelerating the hardening of the brick, it is possible to unload these brick from the car and deliver them on the job in less than 48 hours after they are molded. Of course, this is not recommended as good practice. However, owing to the insistent demand for these brick, this was done when the very first brick were turned out and the breakage was no greater than is common with ordinary run-of-kiln red clay brick.

After 24 hours in the curing rooms the brick cars are run out on tracks in the storage yard and unloaded. By means of a transfer cable the cars are returned to the tracks leading into the plant, where they are again loaded for their daily round.

For the delivery of brick to the job the company uses a dump body truck especially designed for handling 2,400 brick at a load. For loading, the body of the truck is placed upright on the ground, the tailboard of the body serving as a pallet on which the brick are piled. The truck backs up to the loaded body and picks up both the body and its load of brick. On arrival at the job the body is moved off the rear of the truck and stood upright again with its contents of brick. The body is then withdrawn, leaving the 2,000 brick piled on the wooden pallet which formed the tail board of the truck while in transit.

Working one shift, the capacity of the plant is 100,000 common brick per day. While colored face brick may be made in the same plant, it is the policy of the management to concentrate on maximum production of natural color or common brick. The color of the product is a warm grey bordering on buff. The sand being a light brown, the mixture of sand and cement gives a pleasing tone, which appeals to architects and builders alike. The brick are strong, hard, but not too hard to split with a trowel, and true to size, with straight, sharp edges. Their absorption is sufficient to hold them from slipping in the wall while laying up.

The successful operation of a cement brick plant does not depend upon the ability of a mixer to produce mortar, or of a machine to mold and tamp brick, or of a curing system to harden them. Success depends upon the proper co-ordinating and connecting up of the essential units with labor saving, mechanical equipment to serve them in such a manner that continuous operation at highest capacity can be maintained, day after day. There lies the problem and there lies the answer to the brick plants failed or fallen short of the success expected oft-repeated question—"Why have so many concrete brick plants failed or fallen short of the success expected of them?" It is their inability to sustain capacity output.

The brick machines are especially built power machines furnished by the Anchor Concrete Machinery Co. There are three stationary, two-hopper, continuous mixers, specially built by the Kent Machine Co., similar to its No. 2½ machines.

The equipment for delivering the sand consists of three units: First, a standard belt conveyor, receiving the sand from the storage bins and delivering to a standard continuous bucket elevator, which in turn delivers to a special flight conveyor. The belt conveyor and the bucket elevator were furnished by the Link Belt Co. The flight conveyor was furnished by the Chain Belt Co.

The sand cleaning equipment consists of a Champion scrubber screen, a specially built sand washing and settling box, both furnished by the American Road Machinery Co. The cableway was furnished by the Flory Manufacturing Co., and is equipped with a Hayward 1¼-yd. type G clamshell bucket. The cars on which the brick are loaded from the tamping machines are specially built rack cars, some furnished by Frank H. Robinson, Pittsburgh, and some by the Chase Foundry & Machine Co. The dump body truck is of the Fontaine demountable truck body type, furnished by the American Truck Body Co. Brick flux is furnished by the Granitex Co., New York City. The enterprise was initiated, organized, financed, designed, constructed and put into operation by the Cemprod Engineering & Construction Co., New York City., with the writer as consulting engineer.

Concrete Houses

J. C. Pearson, chief cement section, United States Bureau of Standards, will present a paper at the Institute convention in Cincinnati, January 22-25, based on a careful investigation of many examples of concrete house building. It will have the broad title: "Thoughts on Concrete Houses." The paper will call attention to various features of concrete houses more or less characteristic of this type of construction. Points of interest and importance to the designers, builders, and prospective owners of concrete houses will be discussed with a view to creating a fair and unbiased consideration of their merits and possibilities.

The January issue will review concrete Road-building progress. The February issue will be the annual House-building number.

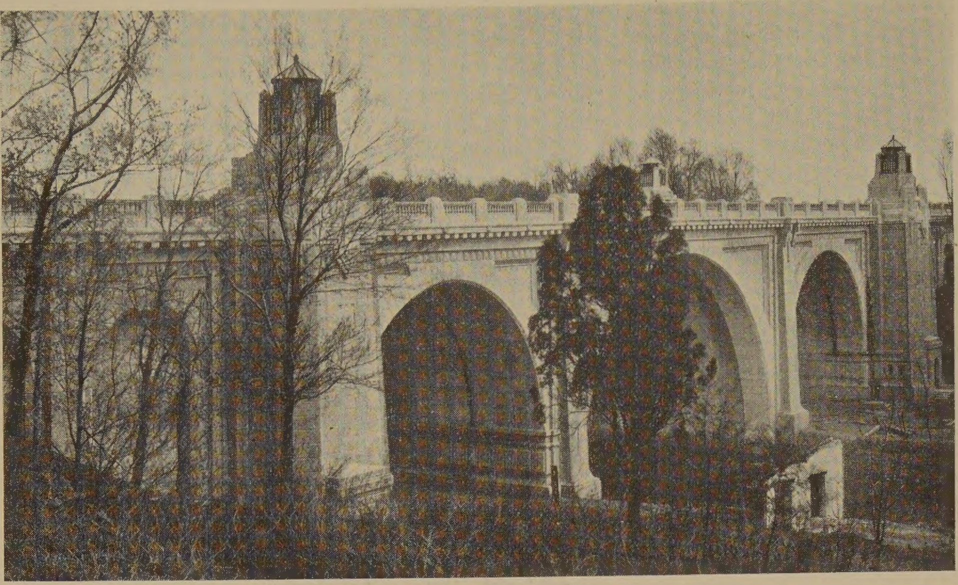


Fig. 1.—The Bensalem Avenue Bridge in Philadelphia, Showing the Pylons as They Appear on the Bridge.

Concrete Bridge Has Interesting Ornamental Features

By John F. McClarren

The artistic value of concrete in bridge construction is presented to an exceptional degree in the Bensalem avenue bridge, which has just been completed in Philadelphia. In the construction of the bridge the engineers concentrated their efforts on developing the possibilities of concrete in the matter of ornamentation, with the result that they have presented what is considered one of the most definite and successful efforts ever made along these lines, and at the same time accomplished results which were thought by many to be impossible, so far as concrete is concerned.

The bridge is 585 ft. long, in three spans, with a driveway 54 ft. wide and sidewalks 12 ft. wide. The handrail of the bridge is 69 ft. above the creek bed. Each of the two bridge arches are of solid concrete, semi-circular in form, and these have solid concrete spandrel walls. The approach walls are of gravity mass concrete. The central span of the bridge has a width of 100 ft. It is made up of six arch ribs of mass concrete, these being poured of 1:2½:5 mix. Each of the ribs is 7 ft. wide and 2 ft. 6 in. at the crown, increasing in thickness to 6 ft. 8 in. at the springing line. The earth fill of the roadway is carried on these main ribs and reinforced concrete slabs. The latter are 15 in. thick and span the sloped back to permit the free entrance of the fill to the opening in the arch ribs. The slabs are of 1:2:4 concrete, and the spandrel walls are of 1:3:6 concrete.

In the construction of the spandrel walls expansion joints at about the third joints were provided.

Ornamental Features

Much is added to the appearance of the bridge by the use of heavy pylons at the abutments of the two side arches, as well as by lighter pylons at the abutments of the main central arch. While the bridge throughout is replete with ornamental features, all in concrete, what may be considered as the main ornamental details are found in the four large pylons which are located between the 60 ft. arches and the wing walls. These extend from the ground level, that is, the level of the creek under the bridge, to 25 ft. above the sidewalk level of the boulevard. At the top of each pylon there is developed in ornamental iron a huge lantern equipped with orange colored glass. This iron work and the oak door which is at the base of each pylon represent about all in connection with the bridge which is not concrete.

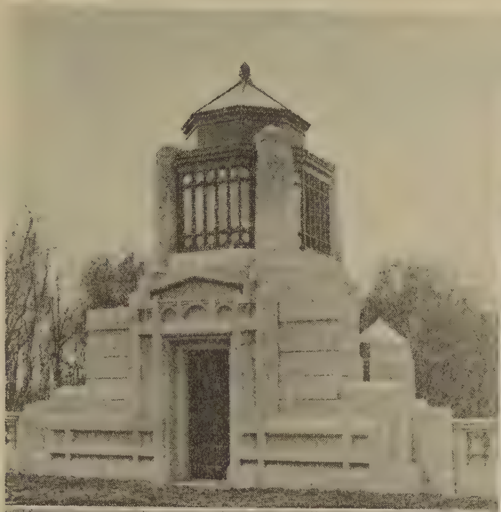
The pylons are so constructed as to provide at the base room space to be occupied by the guard, and extending from one of the rooms is a spiral stairway to the top of the bridge.

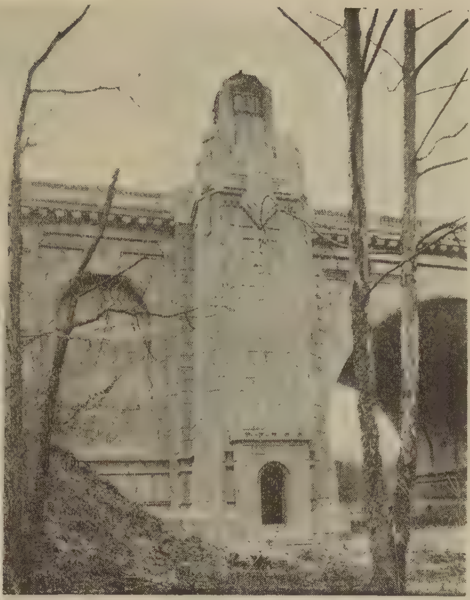
Most of the concrete ornaments on the bridge are built monolithic with mass concrete, excepting the railing, which is pre-cast. The concrete in the overhanging coping weighs approximately 1,200 lbs. per linear foot.

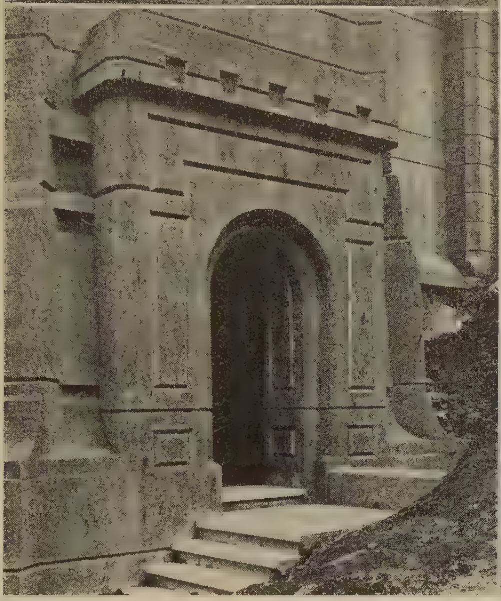
The manner in which the exposed surfaces on the bridge sides were treated and the result obtained make this phase of the work especially interesting. The surfaces are buff in tone. This was obtained by using a facing mixture the aggregate of which is a small dark brown pebble. In the preparation of this finish, and in order to save the expense incidental to the purchase of pea gravel, the contractor screened a portion of the gravel received for making the concrete. This was done with a small rotary screen, which was fed by means of a guy derrick through a 10-yd. hopper. The derrick reached both the hopper and the large gravel rejected by the screen. The pea gravel was deposited in a separate pile near the north abutment, and was taken from that point to the point where the concreting was in progress in wheelbarrows or in buckets on an inclined track.

The surface mortar was deposited behind steel plates about 1½ in. from the face of the forms. This mortar was mixed by hand near the form. It was found economical to raise the forms as the concreting progressed. The pea gravel mortar, being much richer than the concrete, a considerable saving was effected in making the surface coat as thin as possible.

The pebble finish was secured by the removal of the forms within a few hours, when the weather was warm, or within two or three days when the weather was cold,







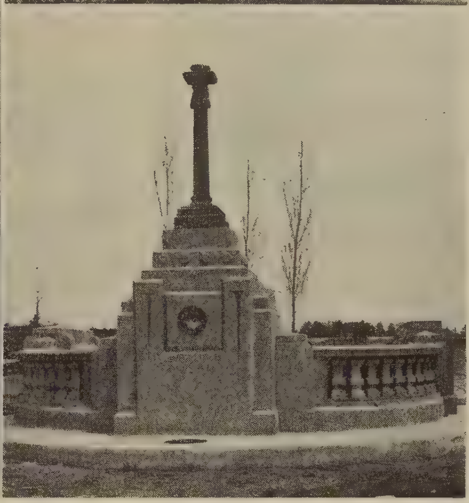


Fig. 2. (Upper Left). A Pylon of Bensalem Bridge from the Deck of the Bridge.

Fig. 3. (Upper Right). Outside View of a Pylon.

Fig. 4. (Lower Left). Showing the Details of the Ground Doorway to a Pylon.

Fig. 5. (Lower Right). A Deflector of Traffic at the Approaches to Bridge. The Large Disc in the Square Immediately Under the Metal Ornament is a Bull's Eye, Twelve Inches in Diameter.

and applying the proper surface treatment. The surface of the concrete was washed with a hose and scraped with wire and fiber brushes, which had the effect of removing the mortar to a depth of ¼ in. to ⅜ in., and leaving the washed quartz gravel pebbles exposed. The principal surfaces finished in this way were vertical, and as the sections were massive, the necessity for maintaining the vertical depth of each day's concreting within the limit which would permit stripping the forms after the concrete had taken the initial set, was kept in mind. It was found that this did not reduce the rate of progress.

Layout of Contractor's Plant

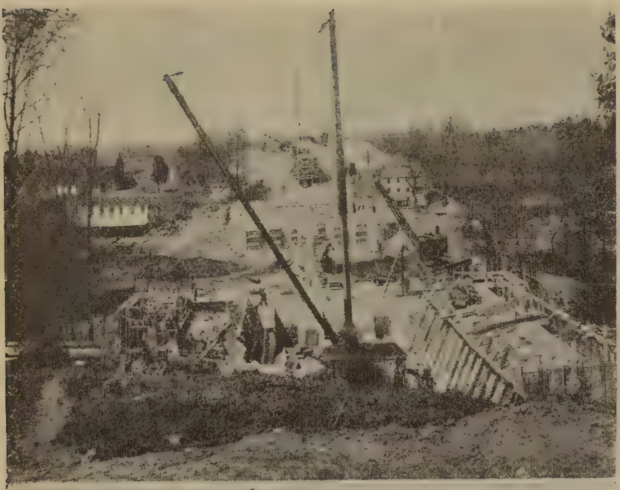
In laying out his plant for the construction of the bridge, the contractor prepared to handle virtually all the materials by gravity. He constructed a standard-gauge railroad siding about a mile long, which connected with a branch of the Pennsylvania R. R. lines. A trestle was prepared back of the north abutment so the cars could be dumped or loaded by a guy derrick, which was set directly in line with it. Cement was stored on the east side of the track and carried to the mixing plant on a plank runway under the trestle. Sand and gravel were stored on the ground on either side of the trestle. Material cars were handled by a dinky belonging to the contractor.

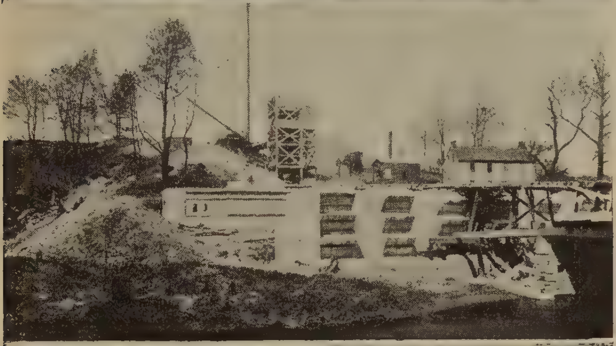
The mixing plant consisted of a Haines gravity mixer mounted upon hoppers of 16 yds. capacity, and located between the walls of the abutment itself. The concrete was placed in the piers up to the springing line and was discharged into one yard buckets on platform cars which ran down an inclined trestle to the desired point.

An interesting feature of the plant was developed at this point. The two cars were attached to the end of a wire rope, which passed around a large sheave provided with a brake at the head of the incline. The rope was made of such length that the cars met and passed on a turnout, the loaded car pulling the empty car up the incline.

In carrying on the work at the south pier and south abutment of the bridge, a large guy derrick was set back of the abutment wall and a locomotive crane was used in connection with the work on the north pier and abutment, the crane running between them. The crane operated on a short track laid on the ground in such a way that its cab would not pass under the concrete trestle. Because of this, one pair of stringers and the section of track which they carried were made up in a unit so that the section could be lifted out of the trestle by the crane and then be replaced after passing through the gap.

In connection with the construction of the arch centers of the bridge, it was necessary to remove the concrete trestle and replace it with a high level trestle built on





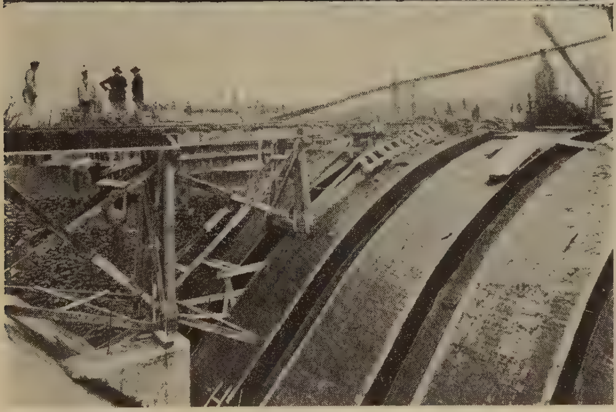


Fig. 6.—The Plant Layout for the Construction of the Bensalem Bridge. Note the Standard Gauge Railroad with its Turnout, one of the Features of the Plant.

Fig. 7.—Abutment of Center Span Under Construction.

Fig. 8.—The Center Arch of the Bridge Showing the Waterproofing of Concrete Ribs.

the east side of the bridge for the locomotive crane, the crane picking up the buckets filled by the mixer and depositing the concrete in place. The crane had a radius of 50 ft. and was consequently able to cover the north half of the bridge without moving.

The bridge was designed in the Bridge Division of the Bureau of Surveys, Department of Public Works, Philadelphia, and constructed under the supervision of that division.

Albert L. Smith was the inspector originally in the field for the City but was fatally injured in an accident which occurred at the site of the bridge. He was succeeded by Alexander Kalijan. Carl Camp was the superintendent in the field for the contractors.

The total cost of the bridge was about $236,000.

Concrete Blocks Protect River Bank From Flood

Concrete blocks were used to pave the bank of the Osage river at the United States lock and dam, about seven miles above Osage, Missouri, to protect the bank from floods. The blocks used were 2 ft. square and 4 in. thick. They were cast at the Government boatyard at Gasconade, Mo., and towed on barges the 41 miles to the site where they were used.

The bank was prepared by grading to a 2½ to 1 slope, using a scraper that was operated with power from the steam capstan of a river dredge. Along the toe of the slope piling was driven 20 ft. into the river bottom and wales were bolted to the piling. A sling attached to the boom of a dredge was used in handling the concrete blocks.

In order to solidify the whole work and hold it together securely, the blocks were made of a special design and fastened together when laid. Two lengths of ⅜-in. galvanized strand were placed on top of the reinforcing mesh running through the center of each block. At the ends of these strands were eyes or rings. The blocks were laid so the sides with the rings pointed towards the top of the bank and towards the river. The lowest row abutted on the wales. The second row was so placed that the rings adjoined those of the first row. Through these pairs of rings short U-shaped wire ropes were hooked and then the ends tightly twisted. This step was omitted on every third row, and instead a long wire rope was run through the eyes from one end of the paving to the other.

At the top of the bank wire rope was attached every 50 ft. to the nearest continuous cable, and the ends were fastened to deadmen. All the joints were filled with river gravel, and then grouted with Tarvia to prevent plant growth. To complete this paving, 5,000 blocks of concrete were required.

The work was under the direction of Major Gilbert Van B. Wilkes, Corps of Engineers, U. S. A., with F. Y. Parker, U. S. Assistant Engineer, in local charge.

Handling Concrete Blocks for Paving River Bank at the United States Lock Above Osage, Mo. The View at the Right Shows a Section of the River Bank After It Has Been Paved with Concrete Blocks

High Alumina Special Cements Are Slow Setting and Quick Hardening

> It is not always apparent that we need a thing until somebody else has it. We can't fully realize the shortcomings of our own cements until we learn what remarkable possibilities develop from such binders as *Ciment Fondu,* and kindred products in Europe. Several articles have been published recently in the Mill Section of CONCRETE, describing new French cements, the practical processes of manufacture, which the makers seem to have well in hand.
>
> Enough general information on the subject is now available to be of interest and value to cement users—from products manufacturers to the designer and builder of the larger concrete structures, and a resume of the various discussions is here published, followed by an article just received from Henry J. Harms, until recently in France and now in Rotterdam.

Alumina cements, which are coming into quite general use in France, under various names, are of interest to all users of cement as well as to cement manufacturers, because of the remarkable property claimed for the special cements, that they produce concrete having a greater strength in 24 to 48 hours than ordinary portland cement concrete develops in 28 days. Various names under which these special cements are referred to are: Cement Fondu, Alumina Cement, Fused Cement, High Alumina Cement, Electric Cement. While various names are applied and different methods employed in making the product, the results are practically the same. It has been found by M. Bied that fusion is not necessary in making alumina cement, and experiments are being made in the use of rotary kilns, which to date have not proved very successful. The name "ciment fondu" refers more particularly to the cement produced by the Societe de Lafarge.

Experiments conducted in France show that the so-called ciment fondu is indecomposible in sea water, or sulfate waters, and it sets normally and hardens very rapidly, giving a concrete which solves construction problems where either salt water or alkali soils are encountered. That a cement that will set normally like ordinary portland cement, but will harden very rapidly, has very obvious commercial possibilities, is pointed out by E. Candlot. Its use as artillery mountings during the war is well known in France and Germany, at least.

According to statements attributed to M. Bied, another French investigator, the property of slow setting and rapid hardening permits dismantling of floors of concrete in which the ciment fondu is used, after 24 hours, and of beams at the end of days. The manufacturers recommend as a perfectly safe figure for designing, a working stress three times as high as with portland cement. Compression members may be figured at 2,000 lbs. per sq. in., instead of 700 lbs., as generally used for portlands. This permits the reduction in appreciable proportion of the dimensions of compression members such as beams and columns. It is pointed out that these advantages and the saving in form lumber resulting from the diminution in the section of compression members, together with the fact that the cement absolutely resists the action of sea water and selenetic water, more than compensate for the increase in price, which is still very much higher than that of first class portland cement. The price of the special cement is approximately two and one-half times the market price of portland in the same region.

It is claimed by the Bureau D'Organization Economique for the French electric cement, that it is gauged like the ordinary portland cements, but is distinguished from them by the altogether special qualities that it hardens rapidly and gives high strength at early periods. The following table shows strengths, given by Spackman, for concrete mxied 1 part cement, 1 part sand and 3 parts gravel; also strength of concrete mixed 1 part cement, 1½ parts sand and 3 parts gravel. These concretes continue to show slowly increasing strength with time.

TABLE 1

Mix	2 days	3 days	7 days	28 days	3 mos.
1:1:3	....	7500	....	8500	9000 lbs. per sq. in.
1:1½:3	5750	....	6000	7500	7750 lbs. per sq. in.

In Fig. 1 is shown a comparison of the tensile strength of ciment fondu with that of portland cement in a 1:3 cement sand mortar, based upon values given by M. F. Carin in *Revue des Materiaux ded Construction et de travaus Public.* The values have been converted from kilograms per square centimeter to pounds per square inch.

It has been pointed out that the employment of ciment fondu is especially advantageous for all work which must be rapidly put into service, such as pavements, roads, repairs and work which must be executed between two tides. It is recommended for the construction of reservoirs, water pipe, etc., because it gives a concrete very dense and impenetrable and one which stands transportation almost immediately after casting.

Owing to the higher price, the use of alumina cements in France have, according to Spackman, been confined to work similar to that mentioned above, where the special qualities are more important than price. It is evident that an economy will be found in its use for the manufacture of roof tile, paving blocks, and precast concrete, as the molds can be quickly removed and do not have to remain out of use for any length of time. Certain constructors propose to use ciment fondu in the construction of bridges and large arches. Its quick hardening characteristics make possible new methods of construction, whereby false work and centering are

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[1] *Engineering News-Record,* May 18, 1922.

largely eliminated. The possible uses of ciment fondu correspond with its remarkable mechanical properties.

One very important fact to be borne in mind in connection with the use of the ciment fondu is that it cannot be used together with or mixed with other cements or lime, and great care must be taken in mixing that all utensils, mixers, shovels, etc., have been carefully cleaned, so that no trace of other cement or any lime is left. This fact must also be borne in mind in connection with the grinding of the clinker, since a very small amount of clinker left from grinding ordinary portland cement seriously affects the setting time of the finished product. In using tube mills that had been previously used for grinding other cement or lime, it was found that the first few tons had to be rejected on account of the quick setting and slow hardening properties of the product.

RAW MATERIALS

The raw materials used in making ciment fondu are ferruginous bauxite and limestone. Fusion may be affected either in an electric furnace or in a water-cooled blast furnace. If in the lime aluminate, pure alumina is replaced by commercial bauxite, the small amount of silica and iron oxide introduced give a new series of products, which are not only quick hardening, but gain strength after hardening like portland, and are specially resistant to chemical attacks from sea water or otherwise. Practically the same results are obtained in the electric furnace as in the water-jacketed furnace.

The difficulty of fusion of alumina cement lies chiefly in its low conductivity. The desire to decrease, if possible, the fuel used has led to the experiments with the electric furnace. With bauxite and limestone as raw materials, the power consumption for manufacturing the cement is given as 2,000 kilowatt hours, viz., about 1,720,000 calories, or about 7,000,000 B. T. U.

The wear of the electrodes in the electric furnace is important. The formation of the gas, CO, which is very active at the high temperature of the electric furnace, causes the electrodes to use up rapidly.

Because of the small quantity obtained in clinkering, a high alumina mixture in a 235 ft. rotary kiln at the Lafarge mill, M. Bied took up work with a water-cooled blast furnace, and for some years past ciment fondu has been produced at one of the plants at Le Teil, where a blast furnace is run with hot blasts and continuous flow of the products. The electric process is in commercial use at Argentiere.

In order to handle the iron which is reduced from the impure bauxite in the water-cooled blast furnace, the coke consumption is higher than necessary for simple fusion of the mix. According to E. Candlot, unless some means is found of utilizing the excess heat, the cost of this process, with coke at its high French prices, will be greater than if it be carried on in the electric furnace.

One noticeable property is that the alumina cements are not so much affected by the variations in the degree of calcination, which may vary from that just sufficient to cause sintering to complete fusion, and they can be produced in furnaces of widely different types.

EARLY HISTORY

Investigations were first carried out in this country by Henry S. Spackman about 20 years ago, and in 1909 the Aluminate Patents Co. was formed for the commercial development of the Spackman patent. The interference proceedings between Spackman's application and M. Bied's were decided in favor of Spackman. The first work was done in collaboration with E. W. Lazall, and later with E. L. Conwell. Laboratory studies were made of the various silicates, aluminates, and ferrates of lime which were then thought to be essential in portland cement. The purpose in making these various low lime aluminates, according to Spackman, was to ascertain the minimum amount of lime necessary to make the alumina active and cause it, on being added to the lime, either in the form of oxide or hydrate, to combine with it.[1]

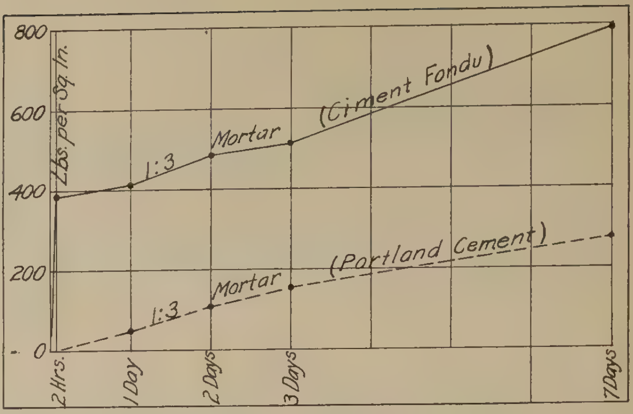

FIG. 1—DIAGRAM SHOWING STRENGTH OF 1:3 CIMENT FONDU MORTAR AS COMPARED WITH PORTLAND CEMENT MORTAR

According to Mr. Spackman, Jules Bied, director of the laboratories of J. & A. Pavin, Lafarge, Le Teil, France, began the study of calcium aluminates some time previous to 1908, and the investigations covered much the same ground as the work done by Mr. Spackman and practically the same conclusions were drawn. Bied, however, concluded that the fusion of the bauxite and lime mixture was essential to the production of cement, and Bied's work was confined exclusively to determining the value of the low lime aluminate for use as a cement. As a result of these laboratory investigations, ciment fondu was placed on the market in France about 1912.

Recent investigations by P. H. Bates, of the Bureau of Standards, led to general conclusions corresponding to those of Bied and Spackman. One conclusion, however, is drawn by Mr. Bates which is not in accord with the experiences of Mr. Spackman and M. Bied in their laboratory work, nor with the results obtained by actual use in construction work in France, where cement of the special nature has been used. Mr. Bates states that the methods of storage of the test pieces showed that these cements had their strength rather materially reduced by the absorption of moisture. This is considered a very vital point.

Ciment fondu is indecomposible because its hydraulic index is very high and because its hardening is not accompanied by the liberation of lime. Its indecomposibility has been proved beyond doubt by experiments carried out in the Lafarge laboratories since 1908, where cubes of lean mortar have been immersed in saturated solutions of sulfate of lime and in solutions of sulfate of magnesia containing 18 grains per litre. Numerous other cements showed indisputable signs of decomposition at the end of a few months, but nothing of the kind was shown in the case of the ciment fondu.

The hydraulic index is the ratio of silica plus alumina to lime. For portland cement this is about ½ and the modulus of silica or the ratio of silica to alumina is about 3. Ciment fondu consists of practically the same materials, but in an entirely different proportion. The hydraulic index for ciment fondu is about 1.25 and the modulus of silica 0.25.

TABLE 2

Portland Cement	
Silica	22—30%
Alumina	6— 7
Iron peroxide	2—3
Lime	57—66
Ciment Fondu	
Silica	10%
Alumina	40
Oxide (iron)	10
Lime	40

The usual composition of portland cement and that of ciment fondu are given by Carin as in Table 2.

In ciment fondu the silica is combined with the lime in the form of calcium bisilicate, and with alumina as calcium aluminate, whereas in portland cement the combination is by tricalcium silicate and tricalcium aluminate.

In color, ciment fondu is not white, but slate like. Its specific gravity is 3, and it has absolutely no voids.

3:4:8 Mix Gives 6,000 Lbs. Strength in 48 Hours

BY HENRY J. HARMS, JR.
ROTTERDAM, HOLLAND

Some time ago the writer gave the story of "Electric Cement" in its present status,[1] but purely from a manufacturing standpoint. In the present article I will give some more practical details and reports on practical tests and applications made. The authors quoted are M. Bied, cement and lime expert, and M. Magny, civil engineer, the same as in the previous article.

LABORATORY TESTS

SETTING TIME, PASTE OF NORMAL CONSISTENCY

	Kept in Moist Air	Kept Under Soft, Fresh Water
Beginning of set	3 hrs. 30 min.	4 hrs. 5 min.
End of set	4 hrs. 40 min.	6 hrs. 0 min.

STRENGTH

For pure cement pastes and for 1:3 plastic mortars, submerged under water after 24 hours' air-hardening. The cement used left about 7% on a screen of 4900 openings per square centimeter (about 185 mesh). Standard briquettes.

TENSILE STRENGTH

Sample		2 days			7 days		
		Kilos	Lbs.	Mean Lbs.	Kilos	Llbs.	Mean Lbs.
1	Cement paste	51	725	....	67	953	....
2	Cement paste	69	981	850	72	1024	988
1	Mortar	28	398	....	34	483	....
2	Mortar	32	455	426	36	512	497

COMPRESSIVE STRENGTH

		2 days			7 days			28 days		
		Kilos	Lbs.	Mean	Kilos	Lbs.	Mean	Kilos	Lbs.	Mean
1	Cement	507	7209	....	642	9129	....	727	10338	....
2	Cement	439	6243	6726	501	7124	8126	506	7195	8766
1	Mortar	224	3185	....	305	4337	....	312	4436	....
2	Mortar	315	4507	3846	433	6157	5247	463	6584	5510

CRUSHING STRENGTH OF CONCRETE

Measured on cubes of 8 in. by 8 in.; moulds kept on, in damp air, for 24 hours, then dismantled and stored outside.

Proportions: 300 kilos Cement; 400 liters Seine Sand; 800 liters Screened Seine Gravel; and 7.8% Water
2nd Proportions: 400 Cement, 300 Sand 900 Gravel, 7.7 Water

	2 days		7 days		28 days		84 days	
	K's.	Lbs.	K's.	Lbs.	K's.	Lbs.	K's.	Lbs.
Concrete No. 1	423	6015	437	6215	533	7580	553	7864
Concrete No. 2	530	7538	538	7651	605	8603	639	9087

PRACTICAL TESTS AND APPLICATION

Messrs. Sainrapt & Brice (Paris contractors) had to construct, for the Nord Railway, large coal silos, the foundations of which had to traverse a layer of quicksand. Caissons were used that were sunk, excavating the sand inside them. The largest one, measuring 24.40 m. by 7.55 m. (79.05 ft. by 24.77 ft.), had to be sunk to a depth of 7.25 m. (23.79 ft.) and had to serve as a foundation of part of the silos, and also as machine room.

The contractors decided to use electric cement, on account of its strength being more than double the one of ordinary cement, and also for its rapid setting, whereby it would be possible to sink and load the caissons almost immediately after they were poured. They gained thus some 14 weeks.

The caisson had to be loaded with a charge of almost 200 tons, and during its sinking serious deformations were observed, caused by the very unequal resistance of the soil encountered; once in place, the permanent deformation was nil and no cracks were observed.

Tests were made, under field conditions, with test-beams of 4 m. (13.12 ft.) span and of the section shown in Fig. 2.

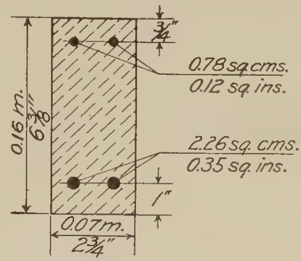

FIG. 2

Proportions: 350 kilos Cement per cu. meter of Concrete

The first tests were made 74 hours after pouring, and deflections were measured with deflection meters, amplifying the deformations five times. The load was uniformly distributed.

DÉFLECTION MEASURED

Load on Beam		During Charging		During Unloading	
Kilos	Lbs.	Mms.	In.	Mms.	Ins.
....	....	....	....	4	.157
150	330	1	.039	6	.236
600	1323	7.8	.307	13	.512
900	1984	13.8	.543	17.3	.681
1200	2425	20.1	.791	22.4	.882
1500	3307	27	1.903	27	1.063

These beams were tested 3 months later, to destruction, and gave an ultimate load of 1,800 kilos (3,968 lbs.). Deflections at that time were quite inferior to those observed during the first tests.

Messrs. Perret Bros. (Paris contractors) had to execute some extremely delicate work in the Rue Auber, Paris, for the Societe Marseilleise de Credit, Bankers. It was necessary to take away all supports and interior partitions on the ground and first floors, and to replace them by only a few columns, in order to change a labyrinth of small rooms and corridors into a modern reception hall and administration hall; all this, without interrupting the work of the employees on the two floors, and without disturbing the existence of the inhabitants of the three floors above. On account of the high load per meter, the beams carrying the walls and upper stories are of a relative small span, 5 m. (16.4 ft.). But the beams carrying the skylights are of about 14 and 18 meters span (46 ft. and 59 ft.); their load attains 24 metric or 26 American tons, and their moment 260,000 foot-pounds.

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[1] See Cement Mill Section of CONCRETE, June, 1922, page 113.

It was out of the question to use, for the sustaining of these loads, on such spans, steel beams and girders, as it would have been impossible, in several places, to get them into the building and in place. On the other hand, the use of ordinary cement, making the beams of reinforced concrete, would have necessitated leaving the shoring in place for several weeks—amidst the desks of the employees.

The contractors decided, therefore, to use electric cement and dismantled the beams 48 hours after pouring them; further, they could make them of smaller dimensions than if ordinary cement had been used, whereby a great saving in dead load was further obtained.

The following tests were made before and during this work:

1. Two small beams, of 2.4 in. by 3.15 in. by 6 ft. 6 in. span, each reinforced with two 6 mm. (9/32 m.) bars (about 2.02%), were tested to destruction, with the following result:

Load		Deflection	
Kilos	Lbs.	Mms.	In.
25	55	..	....
100	220	1	.039
200	440	7	.275
300	661	14	.551
400	882	broken	

It was noted, when dismantling, that the beams had cracked near the middle; the crack, visible to the naked eye, went clear through the beam, from top to bottom.

2. A slab was tested of 1 m. (3.28 ft.) wide, the bottom part reinforced, total reinforcing 3.76 square centims (.583 sq. in., or .47%).

With a span of 2 m. (6.56 ft.) and a uniform load of 2,700 kilos (5,952 lbs.), the deflection was 1 millimeter (.939 in.), and the permanent deflection, after having unloaded, amounted to only one-tenth of a millimeter, or .004 in.

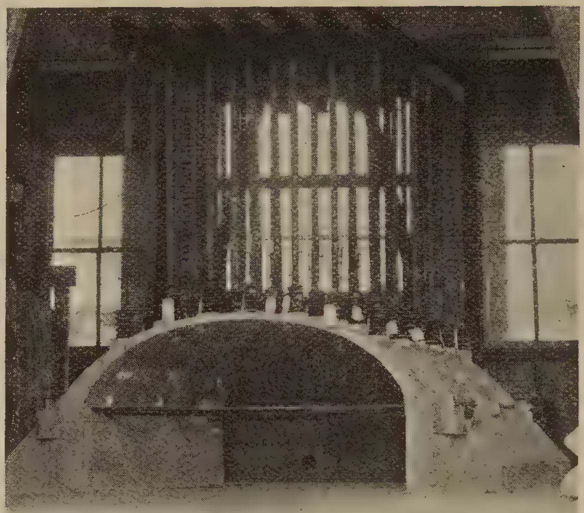
Some interesting work was also done at Bethune, for the Nord Railroad, by L. Peulabeuf, contractor, and consisting of the construction of 150 hung chimneys about 7 m. (23 ft.) high and of 2.2 tons dead weight; also part of a floor of 6 meters span (20 ft.). All this work was regularly dismantled within 48 hours after pouring and proved entirely satisfactory.

The American Concrete Institute convention, to be held in Cincinnati, January 22-25, 1923, will deal with many intensely practical, on-the-job subjects.

Testing for Better Skew-Arch Bridges

A reinforced concrete skew-arch bridge, one-fourth the size of a full-size bridge has been built by the Bureau of Public Roads of the United States Department of Agriculture and is being "tested to destruction" to gain information that will make possible the building of stronger structures of this type.

There are many locations where it is necessary to carry a highway diagonally across a stream. Under such conditions it is customary to build what is known as a skew bridge, and when that bridge is an arch, the arch is known as a skew arch, the abutments or supports not being at right angles with the roadway. When the abutments are at right angles to the axis of the arch the structure is known as a right arch. Engineers can



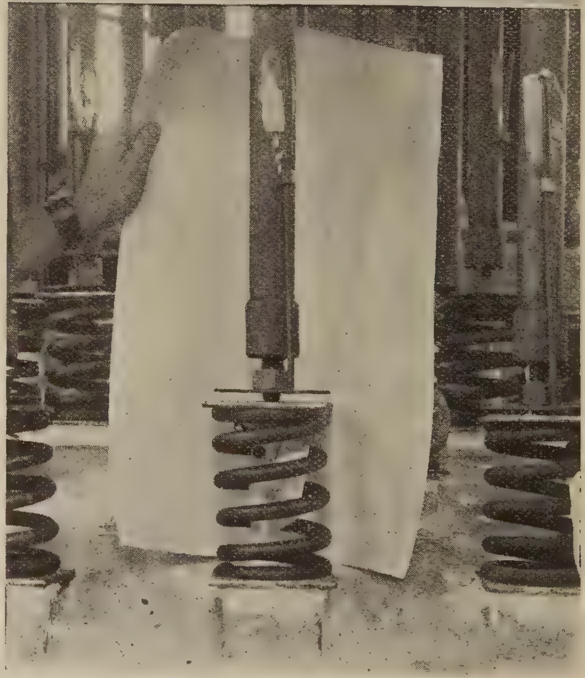


Fig. 1—Test Skew Arch, Showing Method of Applying Load

Fig. 2—One of the 42 Spiral Springs Used at Uniform Intervals on Top of Arch

design right arches very economically, but there is a great difference of opinion with regard to the economical design of the so-called skew-arch.

The principal difference of opinion among engineers is with regard to the manner in which the load is transmitted to the abutments. In the right arch the load on the abutments is the same for each foot of length, but on the skew arch this probably is not the case, and the important question to be settled is the distribution of the load from one end of the abutments to the other.

It was with this object in view that a series of tests has been started on skew arches by the Bureau of Public Roads. At the present time the Bureau has under way at its Arlington Experiment Station a test on a skew arch designed to be one-quarter the size of an actual structure. The arch being tested is 7 ft. in span, 4½ ft. wide, from face to face, and 4 ft. high above the base of the abutments. The crown or midpoint is 2 in. thick, and the barrel of the arch is reinforced with ¼-in. bars bent very carefully into the correct shape.

The arch is being tested with a uniform load and this loading is being accomplished in a unique manner, as follows: 42 spiral springs, each capable of carrying a load of 1,500 lbs., are placed at uniform intervals on top of the arch, and each spring supports a 2-in. pipe, which in turn bears against a solid overhead structure. By adjusting the lengths of these pipes, the springs are deflected and the amount of load applied to the arch may be controlled by the amount the springs are compressed. In this way it is possible to obtain fine adjustments in the amount of load applied without the necessity for piling on heavy weights. As the load is increased on the arch it deflects and the concrete and steel are deformed or strained, and the engineer wants to know how these strains are distributed.

For the measurement of strains in the concrete a strain gauge is being used. With this device it is possible to detect strains with an accuracy of .0002 of an inch. By carefully measuring the strains throughout the arch, it is possible to determine the manner in which the stress is distributed and it is believed that through a series of such tests enough information will be obtained to enable the engineer to formulate rules for the economical design of skew arches.

In addition to determining the strains in the arch, the observations include measurements of deflection of the arch under load, as well as a measurement of the stress in the tie rods between the abutments.

In using gunite in mines, the sprinkling of rock faces to be covered is considered undesirable generally by the United States Bureau of Mines. Timbers, however, should always be sprinkled before guniting. Clean rock faces are essential, however, and if rock faces are dry and dusty, the sprinkling is beneficial unless rock swelling results. Where rock faces are excessively wet the shooting of a thin coat of sodium silicate, water glass, on the rock with the gun, following immediately with the gunite, is advocated.

In protecting concrete from freezing in cold weather construction work, it has been found that one salamander usually suffices to protect 300 sq. ft. of floor space. Fuel should be supplied to the salamander frequently and in small quantities, in order to maintain a uniform temperature and mimamize coke. Moisture should be provided by pans of water on or near the salamanders.

Steel Arch Center Being Moved on Floating Erector

Traveler on Barge Speeds Bridge Building

Unique methods were employed in the construction of the concrete bridge spanning the Susquehanna River at Harrisburg, Pa. A special steel traveler carried on a barge played a highly important part in the building operations. There are in all 46 concrete arches, each span being 66 ft. Practically all of these arches are over the water. It was therefore decided that the steel centers should be carried on a traveler and floated into position by means of the barge. This method was accordingly followed and proved highly practical and successful.

The traveler was of a special design, because of the difference in elevation of the spring line of about 24 ft., from one end of the bridge to the other. To accommodate the varying heights of arches, it was necessary to design a traveler that had one fixed part and two sliding parts. The traveler constructed with this in view could readily pass beneath the centers at the lower end and still be extended to reach the centers at the higher end.

In placing a center, the traveler was towed underneath, then the sliding frames raised up to engage the heel of the steel ribs. Worm geared safety winches were used for this purpose.

The concrete was handled by means of a single narrow-gauge track on the old bridge.

This work is part of the bridge renewal program of the Philadelphia & Reading Ry. One-half of the new bridge, with a width of 13 ft. 9 in., is being built first, traffic being maintained on the present steel bridge. Later, the track will be shifted over to the new concrete arches and the remainder of the bridge concreted. James McGraw Co., Philadelphia, are the contractors.

An interesting concreting operation is being carried out in the construction of the tunnel lining in the Shandaken tunnel, which will carry water from the Catskill mountains to the city of New York. The method, as as illustrated in *Successful Methods,* employs compressed air for placing the concrete in the lining.

The concrete is dumped from the car into a trough or hopper immediately below which is a tank, from which the concrete is forced by compressed air through a hose and deposited in the proper place behind collapsible steel forms. The invert is poured first, then the sides, and finally the top arch.

Equipment Standardization[1]

Job Instructions for Equipment

By Leonard C. Wason
President, Aberthaw Construction Co., Boston

I would sum up my subject—Standardization of Equipment—thus: Is it practicable? Yes. Is it advisable? Yes. To what extent? Everything.

We need you equipment men to help us, because we are really manufacturers in the sense that we assemble crude materials into a finished product. Especially is this true of concrete. We manufacture it into its final assembly. You simply furnish us the tools with which to do this to some extent. In Asia, where labor is worth only a few cents an hour, one cannot afford to use a plant. In the United States, where the other extreme is to be found, the highest paid labor in the world, plant is most desirable and most necessary. In industrial building construction, the mechanical plant runs about 5% of the contract, while the labor of the general contractor is 35%. If we could add 5% to our plant and deduct 5% or more of our labor, we would be delighted to do it. You can help us do this.

Success Through Transportation

If you will analyze the plant that is used in transportation—I use that term in the broadest sense of moving materials from one place to another, and in this sense a shovel is an item of transportation, of course—the greater part of our plant is used in transporting material.

Years ago, when I read the history of the Standard Oil Company, I was very much impressed by the fact that their gain in wealth and power came through their mastery of transportation; to be sure, they did it in rather underhanded ways and secret rebates, but they mastered transportation. Assuming that on the manufacturing end others could produce as cheaply as they and buy raw materials as cheaply as they, yet the Standard Oil Company could move its product from one place to another more cheaply and there lay the secret of its success and power.

In construction work, in building, especially, there is more hand labor used than in any other form of manufacture that I can think of, and particularly is this true of the final assembly. I have never been able to think of a tool which could possibly lay bricks, or assemble lumber in a house. But if you, gentlemen, devoting your attention to equipment, can concentrate your thought on the final assembly of building material and master those two problems alone, you will be a great blessing to yourselves in the way of selling equipment and a great help to the industry and the individual contractor.

Standardization

Now, what of standardization? What are the advantages to the contractor of standardizing?

Very briefly, he saves in the number of sizes of the machines which he has to carry. If he has from 12 to 20 concrete mixers, he saves in that he has to carry only one manufacturer's machine in the two sizes. When the machine is practically worn out, it is possible to take the repair parts off of an old machine and put onto a new machine; and, if those parts happen to be good, he will have a new machine where before he had a collection of old ones.

Another saving is that, in the ordering or carrying of repair parts, he has to stock only one kind. The master mechanics on the job understand that machine and can repair it, and can do it much more easily and cheaply than they could if they had several different machines. Then the question of operation enters in and, if there are only two machines, the operators know how to operate both of those machines.

Another reason for standardization is the matter of service. If there is located in our territory a certain manufacturer of equipment, while other manufacturers may produce just as good, since he is right there to attend to service at a moment's notice, if we specialize in his equipment, he is going to be able to give us service cheaper and better when standardization is in effect. Of course, not all manufacturers can maintain depots in every large distributing center, but on certain lines it seems to me perfectly possible, as in the case Mr. Greensfelder was illustrating on shovels. Different manufacturers might make tools so that they are interchangeable. Boilers have long since been standardized as to capacity, hoisting engines likewise, and one could pretty nearly buy a boiler or a hoisting engine from several manufacturers where the parts would be interchangeable. If that were done, the contractors would have the advantage of competition, which would be like the different branches of one big organization competing with one another to get the best results possible. If I were doing business in a locality very distant from our base, I could buy the equipment of some manufacturer at that point to fit the equipment that we had already on the ground, and it would be a great benefit and a great saving to me.

How Is Equipment Selected?

How do we make the selection? Sometimes it is possible by a study of catalogs, or by examination of machines in operation. If they have been sufficiently perfected, so that we can try out several, from that experience with several we can determine which is the best one to us.

To what extent shall we standardize? Some articles I would not recommend that the contractor carry in stock—a derrick is one. Years ago we had to use a derrick between two buildings where it was necesssary to reach the entire space between two walls with a certain length boom. We went to a dealer who rented them and who had 38 different derricks in stock, and not one fitted; he had to make a boom to fit. If that usually happens, there is no sense in a contractor carrying equipment of that type. But he certainly should carry equipment of the type that he uses constantly and which is not changed.

That brings up the thought that, if it is not to be used constantly, there might be a standard design which can be rented if it is desirable to do so. Unless one keeps a piece of equipment busy on one's own work, or that of others, it is not profitable to own it.

It is also desirable from the contractor's viewpoint to deal with a manufacturer who changes his standards slowly, so that a contractor does not have to be changing repair parts to be inconvenienced by having machines of two different styles, the old and the new. That is almost as bad as two different manufacturers. Certainly, if a manufacturer does make changes, he wants to prove himself successful. If they are not desirable and economical from the contractor's point of view, he should adopt the attitude of letting well enough alone and waiting until he is absolutely sure before he makes the change.

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[1] Courtesy *Associated General Contractors of America.*

Job Instruction for Equipment

I think it is perfectly possible for the manufacturer to write out job instructions for all our equipment. My firm has printed job notes, standardized for its job superitendents, and they write out special ones for the particular jobs which have peculiar points. Therefore, I think it is just as feasible for a manufacturer to have standard instructions or job notes to send out to contractors. We have shown that they can be sent out with good results to job superintendents. I know that, when I have bought new machines and have gotten job instructions with them, I find it mighty difficult to get a duplicate. It occurs to me that, if duplicates were made, if the manufacturer could not afford to give them away, a small charge could be made to cover the cost of printing.

I would like to emphasize in closing the suggestion made by various others, that we form a conference committee between the general contractors and the manufacturers of equipment, so that by getting around the table we can work out our problem together and solve the difficulty; when we meet face to face and learn that the other fellow is a real fellow, when we see his problem, we are more sympathetic and considerate, and we reach the conclusion that it is to our mutual advantage to work out these problems together rather than trying to work them out alone.

The Dilemma of An Industry

Portland Cement Manufacturers Find Themselves in a Predicament

By C. L. Harrison

President, Cape Girardeau Portland Cement Co.

What is an industry going to do when one branch of the United States Government advises it to conduct its business in a certain way and it proceeds to follow the advice it is given, another branch of the Government charges it with breaking the law?

That is precisely the dilemma in which the Portland Cement Industry of the United States finds itself today.

Portland cement was imported exclusively until the early seventies when experiments were begun at Coplay, Pa., by D. O. Saylor. Not until 1875 was Portland cement manufactured in this country.

By 1880 the production of cement in the United States totaled 42,000 barrels a year. In 1890 it increased to 335,500; in 1900 to 8,482,020; in 1910 to 76,549,951, and today it is considerably more than 100,000,000 barrels a year.

Less than fifty years ago there were but two or three men engaged in the manufacture of Portland cement in this country. Today there are 115 plants with an annual capacity of 140,000,000 bbls.

The capital invested in the industry is close to $300,000,000.

The mills in 1920 employed 36,500 men who were paid $61,500,000 in wages.

Now that's rapid growth. And it is only natural that an industry which can build its market so rapidly should formulate a set of trade practices, some of which may be peculiar to that industry and others which may be foond in many industries. To illustrate:

When a contractor prepares a bid on a job in which cement is used, he obtains quotations from a number of mills on the quantity of cement estimated to be needed for that particular job. The cement manufacturer thereupon enters into a contract to supply the cement for a specific job at a fixed price.

Only about one-third of all cement produced is sold under specific job contracts.

In practice, if cement declines in price, the contractor is not compelled to take his requirements at the contract price, but may buy at lower current market prices. But, however much prices may advance, the cement manufacturer must supply as much cement at the contract price as is needed for the specific job.

If the contractor was free to use cement outside of the job specifically contracted for, or to resell it, it would amount to allowing the contractor to speculate in cement at the expense of the manufacturer without any risk whatever.

Should cement advance in price, the contractor having "contracts" with say five mills to furnish 10,000 barrels each for a given job, (requiring only 10,000 barrels), could, in the absence of any restriction, order 50,000 barrels of cement and resell 40,000 barrels at the advanced price.

In binding themselves to supply cement at a fixed price for a specific job, manufacturers willingly perform a necessary service to the community; but in exchange they contend they should be protected against the manipulation of their product by others.

Furthermore, no manufacturer could tell what his commitments were as to quantities to be delivered in future, unless he had means of knowing how much cement was being used on work in connection with which he had quoted prices and engaged to make deliveries.

The cement manufacturers soon saw that the only way in which they could protect themselves against these unfair practices was by organizing and by reporting to each other their specific job contracts, the progress of the jobs and the amount of cement delivered on them. But before the manufacturers did this, they consulted their attorneys and sent them to Washingon to confer with members of the Federal Trade Commission. The plan and purpose of the organization was laid before the commissioners and approved.

To day cement manufacturers are under indictment in New York, Chicago and elsewhere. The manufacturers under indictment produce the bulk of cement manufactured in this country.

The case of the United States of America vs. The Atlas Portland Cement Company et al. will illustrate

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[1] From September issue *Old Colony Magazine*, by courtesy Old Colony Club, Inc.

the Government's charge against the industry. The charge reads, in part:

> That throughout said period of time, said corporate defendants, under the management, direction and control of said individual defendants, have in pursuance of an understanding and agreement among them so to do, carried on their said interstate trade and commerce without any competition between any of the said corporate defendants as to discounts, as to charges for bags, as to credit allowances for bags returned, as to charges for bin tests, as to prices at which they have sold and shipped such cement, or as to the customary dealers to whom they sold and shipped the same, and under these circumstances have sold and shipped said cement in said trade and commerce at arbitrary, non-competitive and excessive prices, and in quantities fixed by agreement among the defendants from time to time during said period.

At a hearing held recently in the United States District Court, Southern District of New York, E. N. Hurley, in testifying what the Federal Trade Commission did in 1915 to help counteract the existing economic depression, made this statement:

> We called in many groups of men in different industries and talked with them about their troubles and why they were working under such adverse conditions, and they made suggestions about what they wanted to do. One of them was, if they could meet with their compeitors and find out the cost of manufacturing from them, and also the standardization of their product, that they thought that would be helpful to them, and *we urged them to do that.*

Exchange of information among competitors—this is one of the things for which the cement industry is being prosecuted today.

Mr. Hurley also testified as follows:

> In the past many manufacturers disliked to give out information concerning their business. Today the reverse is the case. Trade associations are compiling statistics as to production, shipments, and costs for the benefit of their members, and the manufacturer, instead of trying to keep this information to himself, welcomes the opportunity to supply the data, knowing that his competitors are doing the same thing and that these statistics will be of benefit to himself and to his industry. The Federal Trade Commission is keenly alive to the value of this information.
>
> The Commission is urging manufacturers to determine their costs accurately in the interests of better trade conditions. It believes that anything that is of benefit to an industry is of benefit to the public, and it is also of the opinion that the nearer cost systems approach uniformity, the more valuable will be the result.

The Government is now trying to show that cement prices have been substantially uniform since 1916, that the different companies give the same discounts, that allowances for returned bags are uniform, that contract forms are similar and that there is no difference between different brands of cement.

Cement is an absolutely standardized product. It must comply with chemical and physical standards fixed by the United States Government and the American Society for Testing Materials.

A person doesn't have to be an economist to know that with a standardized commodity and conditions of effective competition there is the strongest tendency toward uniform price.

Jevons, in "The Theory of Political Economy," says: "In the same open market, at any one moment, there cannot be two prices for the same kind of article."

Uniformity of discounts, allowances for returned bags, uniformity of contract forms, is the basis of the complaint against the cement manufacturers.

Cement is sold principally through dealers. Anyone who knows anything about marketing through dealers knows that such a method of distribution tends toward uniformity of trade practices. This is merely sound economics.

The dealer seeks the lowest price and the most advantageous terms of sale. All of which tends towards uniformity.

Manufacturers of cement allow the same amount for returned bags. Allowances for returned bags are merely one of the terms of the sale of cement. If one manufacturer allowed more for returned bags than another he would be decreasing the price of cement. He might get more business temporarily, but other manufacturers would follow suit. Once again there would be exhibited the tendency toward uniformity.

The cement industry attempts to establish five points: (1) the presence of competition; (2) a moderate rate of profits; (3) that prices have not arisen as fast as those of other commodities; (4) the formation of an association for the improvement of business conditions, and (5) publicity of all actions.

In law a defendant is judged innocent until proved guilty. The man on the street, however, frequently thinks of indictments as convictions. He fails to realize that the one is based upon accusations and the other upon proved facts.

Any industry guilty of combining in restraint of trade should be prosecuted. The public must be protected against reckless and indiscriminate attack.

The American public is just. It recognized that men go into business for profit. It readily grants a reasonable profit. It will not tolerate profiteering and neither should it permit any influences which will break down business structures.

The dilemma in which the cement industry finds itself is comparable to what other industries face. What is to be done about it?

To begin with, steps should be taken to have the Sherman Law either amended or interpreted so that trade associations may know what they can do and what they can't do.

Water Control in Concrete Mixture

The proposal to specify concrete by strength immediately raised serious questions as to control of the mixture—the water presenting a serious problem because of varying moisture content in aggregates, usually encountered. Bearing on that matter, W. A. Slater and G. A. Smith, of the Bureau of Standards, will present a paper at the convention of the American oCncrete Institute, Cincinnati (January 22-25), on "Inundation Methods for Measurement of Sand in Making Concrete."

There are three parts to this paper. Part 1 gives the results of tests made to study the measurement of sand in water (in an "inundated" condition). These tests indicate that the "bulking" phenomena of damp sand can be almost entirely eliminated and that a high degree of accuracy in the measurement of sand and water can be secured by this method of measurement.

Part 2 gives results of tests made to give a basis for estimating the quantity of water carried into a batch of concrete on the surface of the coarse aggregate when wet aggregate is used.

Part 3 gives results of compression tests of cylinders in which the sand and a portion of the water were measured by the inundation method. The concrete was designed for a strength of 2,000 lbs. per sq. in., and although a wide variation in the gradation of the sand and in the water content of the sand were involved, the resulting strength was reasonably close to the designed strength.

Effect of Sea Water

An investigation with the object of collecting valuable data and improving, where practicable, existing practice in water front construction, is being conducted by the Navy Department, Bureau of Yards and Docks, through a questionnaire recently distributed by the department throughout the naval shore establishment.

Among the questions to be considered is concrete construction, including general descriptions of structures and conditions, types, material, construction methods, conditions, exposure to salt water, salt spray or mist, wave action, abrasion, climatic influences, and atmospheric conditions.

Estimating the Cost of Stone Setting

Block, Terra Cotta, Cut Stone

By Chas. F. Dingman, M. Am. Soc. C. E.

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When we come to estimate the cost of setting cut-stone, including architectural terra-cotta, artificial stone, concrete blocks, and all kinds of natural stone, we can go into a great deal of refinement and can, if we collect accurate data, learn to prepare estimates that should vary but little from the actual cost of doing the work.

In estimating the cost of setting all sorts of ornamental work, as well as natural stone ashlar, the cubic-foot seems to be the most satisfactory unit of calculation and I also prefer the cubic-foot as a basis in figuring architectural terra-cotta, though others figure it by the square-foot of surface area and some by the ton. The individual block seems to be the most satisfactory unit for figuring cement block work.

Cement Block Work

The most common size of block used is 8 in. thick, 16 in. long and 8 in. high, and it weighs from 50 to 60 lbs., depending upon the percentage of core-voids and the density of the concrete used. Blocks 12 in. long and 8 in. high, as well as other shapes, are also used, but not as extensively as the 16 in. by 8 in.

In addition to the "stretcher" blocks, it is necessary to have corner and jamb blocks, as well as lintels. On the better jobs, short stretchers will be provided to make closures.

Various methods of organizing are used for cement block work, but the most satisfactory method seems to be to have a helper for each mason, to assist in lifting the blocks onto the wall, and one man to mix mortar and serve it to each two masons.

Additional men will be required to bring the blocks from the piles, and distribute them along the wall, since the helper cannot be expected to handle them for a greater distance than 10 ft. without delaying the mason.

Makers of concrete block machinery and dealers in the blocks consider about 260 blocks, including jambs and corners, to be a fair amount to lay in an eight-hour day. The figures in our table are more conservative.

Table 1—Laying Concrete Blocks
(Time in Hours per 100 Blocks)

Mason		3.8
Helper		3.8
Mortar man		1.9
Wheelers (per each 100 ft. distance to pile)		0.8
Loading or unloading trucks	Laborers hrs.	0.5
Add for each lin. ft. of corner or jamb to plumb	Masons hrs.	0.06
Add for each lin.ft. of ornamental projecting corners	Masons hrs.	0.05
Mortar	Cu. yds.	0.2

This table will hold good for walls up to 12 ft. high, but, since concrete block walls are seldom used for buildings having a greater story height, it is not necessary to compile a table for greater heights. When the building is more than one story high, allowance must be made for elevating, as explained in brick work.

The time for loading onto or unloading from wagons or trucks is given in the table, and knowing the weight of the blocks ,you can easily compute the cost.

Assume that we have a building 200 ft. long, 70 ft. wide and 12 ft. high, with 48 steel sash each 6 by 8-6, two doors 10 by 10, and three doors 3 by 7, and we wish to compute the labor cost of laying the blocks.

The wall area is evidently:

(2)×200=400
(2)× 70=140

540 lin. ft. × 12 ft. high		6,480
less		
(48)×6-0×8-6	2448	
(2)×10-0×10-0	200	
(3)× 3-0× 7-0	63	2.711
		sq. ft., 3,769

Disregarding the thickness of the joints,

3769 × 144 ÷ 128 = 4240 blocks required.

Assume laborers rate	$0.45 per hour
Assume masons rate	.90 per hour

Blocks delivered by trucks to site and unloaded 100 ft. from working point.

For each 100 blocks the time to be consumed at the job is, therefore, as follows:

Laborers—		
Unloading	0.5 hr.	
Wheeling	0.8 hr.	
Mortar man	1.9 hr.	
Helper	3.8 hr.	
	7.0 hrs. @ .45	3.15
Mason—	3.8 hrs. @ .90	3.42
Cost to lay 100 blocks		6.57

But we must add the cost of plumbing the corners and jambs, which is:

4 corners @ 12 ft.	48 lin. ft.
96 window jambs @ 8½ ft.	816 lin. ft.
4 door jambs @ 10 ft.	40 lin. ft.
6 door jambs @ 7 ft.	42 lin. ft.
	946 lin. ft.
	@ 0.06=56.76 hrs.

4240 blocks laid @ $6.57 per hundred	$278.57
57 hrs. time plumbing corners, etc., @ .90	51.30
Total labor cost	$329.87

If we used a mortar made of 1 part cement, 3 parts sand and 10% lime putty, the cost of the mortar materials would be figured as follows:

2.28 bbls. cement @ 2.80	$6.38
0.08 bbl. lime @ 4.00	.32
0.94 cu. yd. sand @ 1.25	1.18
Per cu. yd.	$7.88
4240 blocks @ 0.2 cu. yd. per 100 =	8.48 cu. yds.
8.48 cu. yds. @ $7.88 =	$66.82

The cost of scaffolding is not included here.

No attempt is made here to cover completely the method of estimating the cost of producing the blocks, since they are usually made in factories and delivered to the job at a fixed price per block.

The cost of making the blocks varies widely with the equipment used. I recently visited two apparently prosperous plants. One, using mechanical tampers, mechanical conveyors, industrial cars, etc., with a gang of eight men, working nine hours per day, turns out an average of 3,300 dry tamped blocks per day. The other plant, with all hand operations, and a gang of three men at work, turns out 700 similar blocks per week.

Assuming a labor rate of 45c. per hour, which is probably higher than actually paid, their costs would be as follows:

Mechanical plant, 8x0.45x9 ÷ 3300 = 1 ct. per block.
Hand plant, 3x0.45x9x6 days ÷ 700 = 10.41 cts. per block.

The cost of the materials used depends entirely upon the mix used, and most block makers are not very definite in stating what mix they use. However, this may be roughly estimated by assuming that the usual mix is not much higher than 1 to 5, which requires 1.20 bbl. cement and 1 yd. sand per cubic yard. Thus:

1.20 bbls. cement @ 2.80	$3.36
1 cu. yd. sand @ 1.25	1.25
1 cu. yd. mortar will cost	$4.61

Since each block of the size under consideration contains 704 cu. in. of mortar, a yard will make 27x1728 ÷ 704 = 66.2 blocks, which would mean that the material cost of each block would be approximately 7 cents.

Assuming usual overhead costs, the comparison of the two plants will be as follows:

	Mechanical Plant	Hand Plant
Materials	.07	.07
Direct labor	.01	.104
Overhead (50% of labor)	.005	.05
Total	.085	.224

Whenever occasion requires that you make an estimate of the cost of producing concrete blocks, it is essential that you get complete data as the equipment available, mixture to be used, size and cross-section of blocks, and all other factors which affect the cost.

Care should also be taken to differentiate between dry-tamped blocks and wet poured blocks.

ARCHITECTURAL TERRA-COTTA

Architectural terra-cotta is essentially a manufactured product and the matter of estimating the cost of production is no more within the province of the construction manager than is estimating the cost of producing any other manufactured article.

It is true that the man who has carefully kept the data as to the cost of terra-cotta on previous jobs is in a position to approximate the cost of similar jobs in the future. However, the price of terra-cotta is varied by so many factors, such as finish, amount of ornament, number of times any piece is duplicated, color, etc., etc., as well as manufacturing conditions and transportation costs, that it is always wise to get a definite quotation based upon the plans and specifications in every case.

Such a quotation may or may not include all necessary anchors. If it does not, then you should secure a list of those anchors from the manufacturers, or from the architect or the plans, and secure a price for them. When you cannot readily obtain a lump-price for the anchors, you can calculate their weight by the tables in your Structural Steel Handbooks and estimate their cost at the current price for builders' wrought iron work.

Setting architectural terra-cotta is an operation very similar to setting cut-stone work, except that its lighter weight usually obviates the necessity for using derricks with terra-cotta and, in those sections where the trades are separated, terra-cotta is more usually set by bricklayers than by stone-setters. When any fitting is necessary at the job, that also is done by bricklayers, generally by those who are particularly expert in the work, rather than by stone-cutters.

On work involving any large amount of terra-cotta, it is well to make sure that the price made by the manufacturer includes the cost of necessary fitting to take care of any incacuracies in the dimensions of the several pieces. It is hardly practicable for the builder to estimate the cost of fitting, since it may be absolutely nothing on one job and run to several hundred dollars on another and similar job.

When scaling quantities of terra-cotta from plans, be sure to take the full "squared" size of all mouldings, projections, capitals, columns, and similar members, and multiply the dimensions into cubic feet. On that basis, the average weight will be between 70 and 75 lbs. per cu. ft., and the cost of hauling may be figured accordingly.

Scaffolding must also be figured.

The cost of handling the terra-cotta from car to truck, truck to wheelbarrows, to the building, sorting and distributing it, as well as setting and cleaning down, may be computed from the following tables:

TABLE 2—UNLOADING, ETC.
(Labor Hours per 100 Cubic Feet)

From car to truck	3
From truck to barrow	3
Wheeling 100 ft.	8
Sorting and distributing	8
(Elevator)	

TABLE 3—SETTING AND BACKING (PER 100 FT.)

	Setting T. C.	Backing
Bricklayer	8 hrs.	4 hrs.
Laborer	16 hrs.	4 hrs.
Mortar	0.16 cu. yd.	
Brick for backing		8

TABLE 4—CLEANING AND POINTING
(Hours per 100 sq. ft.)

	Washing Down New Work	Pointing New Work	Cleaning Old Work	Pointing Old Work
Mason	1.5	1.5	2	2
Laborer	0.75	0.75	1	1

CUT STONE WORK

As with architectural terra-cotta, the production of cut stone has become a manufacturing proposition and is seldom undertaken by a general contractor.

However, there are enough instances where a builder would undertake to produce the stone for a building operation to make it desirable for a construction manager to understand fully how the cost is estimated.

For the present, we shall content ourselves with learning how to estimate the cost of installing the stone in the building, as that is all that the building estimator generally finds it necessary to estimate himself.

Usually when there is any appreciable amount of stone to be used in a building, the companies bidding on it will name a lump-sum figure for all of the stone required. They will also usually give their estimate of the number of cubic feet to be set, thus relieving the general contractor of the necessity of scaling the quantities again, unless he desires to check the figures.

There are many items of stone work, such as sills, lintels, pier-caps, chimney-caps, steps, bond stones, etc., upon which it is possible to secure unit price lists in many localities, and when this is possible, it is well to be equipped with such lists and use them in estimating, even though you may have your own figures checked by sub-bids.

When using such lists, it is well to be very careful to make sure that the list covers exactly the same sizes, kinds of finish, etc., that are called for by the plans and specifications, as it is possible that there may be a very appreciable variation otherwise.

When any special work or ornamentation at all is required, it is well to get special prices.

The cubic-foot, as previously stated, is the most convenient unit for use in figuring stone work, but, of course, the number of cubic-feet that can be handled in a unit period of time will be determined by the size and weight of the individual pieces, their shape, and their position in the work.

Such items as sills, lintels, steps, pier-caps, etc., are usually set by hand, one or more laborers assisting the mason as may be required, but when ashlar facing is used, or when very much ornamental work, such as columns, cornices, etc., is included, it is usual to use a small hand-derrick or a breast-derrick.

Where the individual pieces are heavy, or where the total quantity to be handled runs into several thousand feet, it may be profitable to use a power derrick. However, this should be studied carefully, because it often develops that the mason will not handle the stone rapidly enough to pay the added cost of the power equipment, and the men to run it, to say nothing of the cost of insallation, fuel and removal.

If the stones are large, and no derrick is available for moving them from the car to truck and truck to building, the cost will naturally be higher than where the unloading facilities are good or the stones small.

The following tables contain the information necessary for the preparation of an estimate on any ordinary work:

TABLE 5—UNLOADING CUT STONE
(Labor Hours per 100 Cubic Feet)

	Hand Work	Hand Derrick	Power Derrick or Crane
From car to truck	4	3	2½
From truck to barrow or storage	4	3	2½
Wheeling in barrows per 100 ft.	3		

TABLE 6—SETTING CUT STONE
(Hours per 100 Cubic Feet)

	Hand Work		
	Sills, Lintels, etc.	Ashlar	Small Cornices, etc.
Masons	30	12	20
Laborers	30	20	30
	Using Hand Derrick		
Masons	24	10	15
Laborers	24	20	30
	Using Power Derrick		
	Heavy Foundation Stone	Thin Ashlar	Ornamental Work
Masons	4	8	12
Laborers	32	48	36
Engineer	4	4	4

Note—The figures for power derrick do not include the cost of installing and removing derrick.

Most architectural stone work must be laid in non-staining mortar, the composition of which is usually definitely specified by the architect. It is becoming usual to use White portland cement as the binding principal in non-staining mortars, and when this is done costs apply as in brick work, plus extra cost of white cement.

The quantity of mortar required can be calculated from the following table:

TABLE 7—MORTAR REQUIRED
(Cu. Yds. Mortar per 100 Cu. Ft. Stone)

	Setting	Pointing	Parging
Heavy foundation stone	0.10	0.03	
Thin ashlar work	0.15	0.05	0.15
Sills, lintels, etc.	0.15	0.05	0.15
Small ornamental work	0.13	0.04	0.13
Large ornamental work	0.13	0.04	0.13

Beside the cost of hauling, labor, elevating and mortar, we must include the cost of all anchors and clamps that are specified, being careful to note the number and kind as well as the material of which they are to be made and to get proper prices on them.

After the setting has been completed it will be necessary to wash the work down, using no acid for most stones, and the cost of such cleaning is to be calculated as follows:

TABLE 8—CLEANING AND POINTING
(Hours per 100 Square Feet)

	Washing Down New Work	Pointing New Work	Cleaning Old Work	Pointing Old Work
Mason	2	2	3	3
Laborer	1	1	1.5	1.5

On work which has been exposed to weather for many years, particularly in communities where much soft coal is used, an ordinary washing down, even with a strongly alkaline wash, will not restore the stone to a satisfactory appearance.

It is then necessary to resort to the use of a sand-blast and the work is usually done by "stone-renovators" rather than by builders.

Let us assume for our example that we have a building front, to have a granite grade-course and a limestone-ashlar facing with the usual amount of ornamental work, such as pilasters, caps, bases, cornices, etc.

Our bill of quantities, using the method mentioned in the discussion of architectural terra-cotta, and taking the "squared" dimensions of all members, is assumed as follows.—

Granite grade course	120 cu. ft.
Limestone ashlar	720 cu. ft.
Sills and lintels	150 cu. ft.
Ornamental features	600 cu. ft.
Total	1590 cu. ft.

We will assume that the stone is to be delivered f. o. b. cars at the railroad station, one mile from the job over good hard roads, there is ample room at the work to pile the stone, but as the building is three stories high, we shall have to hoist our stones by a power derrick which we will locate at a point that will serve the entire front and obviate the necessity for re-locating during the work.

To calculate the cost of bringing the stone from the railroad to the buildidng, we will make use of the following table:—

TABLE 9—WEIGHTS OF BUILDING STONES

Granite	170 lbs. per cu. ft.
Limestone	137 lbs. per cu. ft.
Sandstone	164 lbs. per cu. ft.
Bluestone	151 lbs. per cu. ft.
Marble	168 lbs. per cu. ft.
Gneiss	168 lbs. per cu. ft.
Slate	175 lbs. per cu. ft.

The total weight is therefore:

120 cu. ft. granite @ 170 lbs.	20,400
1470 cu. ft. limestone @ 137 lbs.	201,390
Total	221,790

Since we can handle 6000 lbs. to the load, it follows that we shall have to haul 37 loads, which, at 2 miles per hour loaded and 3 miles per hour unloaded will require 50 minutes per load travelling time or practically 31 hrs.
to which must be added the time for loading and unloading. Allowing 2 men, and the driver, at the car, we find the loading time, from Table 5 to be 21.2 hrs.
and for unloading, using the derrick and the same number of men, the time will be 13.24 hrs.

65.45 hrs.

The cost of the driver's time is included with the cost of the team, so it is only necessary to figure the cost of the other two men, or two-thirds of the time indicated in the table, thus:

Loading 1590 cu. ft.x4 hrs. per 100×2-3= 42.4 hrs.
Unloading 1590 cu. ft.x2½ hrs. per 100×2-3= 26.5 hrs.

Total, 68.9 hrs

assuming that enough teams are employed to keep the men busy.

The cost of the derrick engineer will be included in the cost of setting and need not be figured separately.

From Table 6, we learn that the time required for setting the stone will be:

Ashlar work, including sills, grade course, etc.	990 cu. ft.
Masons @ 8 hrs. per 100 cu. ft.	79.2 hrs.
Laborers @ 48 hrs. per 100 cu. ft.	475.2 hrs.
Engineer @ 4 hrs. per 100 cu. ft.	39.6 hrs.
Ornamental work	600 cu. ft.
Masons @ 12 hrs. per 100 cu. ft.	72 hrs.
Laborers @ 36 hrs. per 100 cu. ft.	216 hrs.
Engineer @ 6 hrs. per 100 cu. ft.	36 hrs.
Cleaning and pointing (from Table 8)	1800 sq. ft.
Masons @ 4 hrs. per 100 sq. ft.	72 hrs.
Laborers @ 2 hrs. per 100 sq. ft.	36 hrs.
Pole staging laborers	15 hrs.

SUMMARIZING

Teams, 65.5 hrs. @ $1.00		$ 65.50
Laborers, unloading, etc.	68.9 hrs.	
Setting ashlar	475.2 hrs.	
Setting ornament	216. hrs.	
Cleaning and pointing	36. hrs.	
Staging	15. hrs.	
	811.1 hrs.	
	say 811 hrs. @ .45,	364.95
Masons, setting ashlar	79.2 hrs.	
Setting ornament	72. hrs.	
Cleaning and pointing	72. hrs.	
	223.2 hrs.	
	say 223 hrs. @ .90,	200.70
Engineer on ashlar	39.6 hrs.	
On ornament	36. hrs.	
	75.6 hrs.	
	say 76 hrs. @ .90,	68.40
Total direct labor cost		$699.55
which equals .436 per cu. ft.		

If this job could be set by hand, using a breast derrick and working from the floors as the building goes up, we should figure our cost as follows:

The time of the teams in transit would be	31. hrs.
and at the car	21.2 hrs.
the same as before, but their time at the building would be increased (see Table 5) to	21.2 hrs.
Total team time	73.4 hrs.
The laborers' time at the car would be	42.4 hrs.
as before, but the unloading time at the building would also be	42.4 hrs.
and we also have to allow for time needed in putting stones onto the elevator and taking them off at the upper stories. Assuming 360 cu. ft. of stone to go on the first floor, we have 1,230 ft. to raise to the upper stories, and the distance to handle it will be taken as 100 ft.; therefore, 1,230 ft. @ 3 hrs. per 100, equals	36.9 hrs.
Total for these items	121.7 hrs.

The time required for setting, from Table 6, will be as follows:

270 cu. ft. sills, lintels, grade course, etc.	81. hrs.	81. hrs.
720 cu. ft. ashlar	72. hrs.	144. hrs.
600 cu. ft. ornament	90. hrs.	180. hrs.
Totals	243. hrs.	405. hrs.

The cost of cleaning and pointing will be as before, as also will the scaffolding. Summarizing, we get:

Teams, 73.4 hrs. @ $1.00		$ 73.40
Laborers, unloading	121.7 hrs.	
Setting	405. hrs.	
Cleaning and pointing	36. hrs.	
Staging	15. hrs.	
	577.7 hrs.	
	say 578 hrs. @ .45,	260.10
Masons, setting	243. hrs.	
Cleaning and pointing	72. hrs.	
	315. hrs. @ .90,	283.50
Engineer, 16 hrs. on elevator, @ .90		14.40
Total direct labor		$631.40
which equals 39.7 cts. per cu. ft.		

Without going into the matter of rental expense on the derrick and power, or the elevator, it can readily be seen that the stone-work on the building under consideration can be handled to better advantage with a hand-derrick than with a power-derrick.

This is not an invariable rule, yet it is not at all unusual for a job of this size, as the economy resulting from power equipment does not become effective until we handle much larger quantities of stone.

In *Engineering News-Record* of March 13, 1919, I described an instance where we completed some heavy repair work on a stone dam for less than four thousand dollars, with a hand derrick, though the estimates of our competitors, who contemplated the use of power equipment ran as high as thirty-nine thousand dollars.

That was an exceptional instance. It happened during a period of coal shortage, the nearest railroad was over two miles away and the conditions and the site were such that the cost of installing a steam-engine would have been equal to the total cost of operating the hand-derrick.

New Regulations for Block Manufacture

Block manufacturers who read in CONCRETE for November the letter of J. C. Pearson, Chief of Cement Section, U. S. Bureau of Standards, to A. J. R. Curtis, Secretary Committee P-1, Standard Building Units, of the American Concrete Institute, in regard to block regulations—strength, absorption, etc.—will be interested in Mr. Curtis' reply to Mr. Pearson. The Committee will present a new standard at the Institute Convention January 22-25, in Cincinnati. Mr. Curtis' letter follows:

J. C. Pearson, Chief, Cement Section,
Department of Commerce,
Bureau of Standards,
Washington, D. C.

Dear Mr. Pearson:

It gave me great pleasure to read before Committee P-1, in session on Friday, your very interesting and helpful letter of October 17. In replying, let me discuss each idea in about the order presented.

The circumstances to which you ascribe your increase in interest in this subject are almost common experience across the country, so great has been the demand of building materials and so marked the increasing popularity of the concrete block and building tile. A year ago a check on leading block factories revealed an output estimated at 175,000,000 block; today the same plants are producing considerably over 235,000,000—possibly 300,000,000 block.

This rapidly growing popularity has imposed an increased responsibility on Committee P-1, to get down to brass tacks and produce a practical specification. I am glad to say that the Committee is making steady progress.

In the suspicious frame of mind you have so well described, city building commissioners with a block problem on their hands, no money in their budgets and little dependable information to fall back on, have often made the mistake of increasing an already high compression requirement for block, instead of devising dependable methods of inspection and testing. What is generally needed most is more enforcement.

For example, a certain small city incorporated into its code the 1,000-lb. compression requirement. A building wall collapsed under construction. The block looked poor. The ordinance requirement was changed to 1,200 lbs.—yet samples from the collapsed wall tested 200 lbs. on the average, and two broke while being placed in the machine. Yet the load on the finished wall could not have been more than 40 lbs. to the square inch (heavy garage building) and the legal block in that city must now carry 30 times that much!

In my recent paper before the Building Officials' Conference, I described what I believe to be an efficient method of securing enforcement and emphasized the fact that better enforcement is needed even more than better codes.

The "single quality standard" for block is really not a single quality standard. It is based on the idea that all block for a given purpose or class of use should meet the same test in pounds per square inch over the gross area. Thus, with a 750-lb. requirement on the gross area, the solid block would carry 750 lbs. to the square inch on the minimum cross sectional area, while a 33% air space block would carry 1,075 lbs. on the gross area and some concrete tile might carry 3,000 lbs. on the minimum cross section.

To admit good quality light block and tile where only moderate loadings are required, a second and a third classification are added. To encourage the use of more cinder and other light aggregate block for fireproofing, non-bearing partitions and other similar uses, for which light clay tile is now largely used, a fourth classification is added to admit a block only designed strong enough for this purpose. The Committee has reasoned in this way, and the result is the tentative adoption of a table of requirements very much like what you have proposed:

Heavy bearing, minimum average..	1,200	individual minimum.	1,000
Medium bearing, minimum average	700	individual minimum.	600
Light bearing, minimum average...	500	individual minimum.	400
Non-bearing, minimum average....	250	individual minimum.	200

(In lbs. per sq. in. on gross area.)

Your arguments for greater tolerance are quite interesting, but are rather the reverse of the theory commonly heard in the Committee—that a reduction of the tolerance to a small margin would work for more uniform manufacturing processes—something for which there is great need. It has been felt that in grading and perhaps in effect somewhat lowering the average requirements, there was an opportunity to tighten up on tolerance.

Although the subject of marking block is not within the scope of the work of Committee P-1, I am glad to express a personal opinion fully in accord with yours on that subject. Block should bear means of positive identification. Marking costs practically nothing and can be made of great advertising value. Marking is gaining ground every day.

You will get considerable pleasure in learning how closely your ideas and those of the Committee agree as to absorption. While the matter has not yet been definitely settled, the thought seems to be in one direction. These ideas have been definitely expressed: (a) the absorption test as now applied is not an absolute test for impermeability or quality; (b) the rate of absorption would be more fairly measured in terms of pounds of water per cubic foot of concrete or square foot of exposed area; (c) the 10% limit of absorption is too low, blocks with higher absorption having greater suction, desirable in holding mortar, plaster and stucco; (d) block not to be exposed to soil or weather should not be required to stand any absorption test whatsoever; (e) it has been proposed to substitute for the present test a method by which the block would only be placed in water to a depth of a quarter of an inch, or deep enough to cover the face. Such a test would probably register capillary action satisfactorily, but some question has arisen as to whether it is objectionable in taking no account of percolation.

The Committee is now hard at work on the solution of the block specification problem, with signs pointing hopefully to an early agreement on improved specifications for concrete block which, I hope, will incorporate many of the excellent ideas so well expressed in your letter.

Your interest and offers of future help are appreciated by every member of the Committee.

Yours truly,

A. J. R. Curtis,
Secretary, Committee P-1.

Concrete Block Again Resists Fire

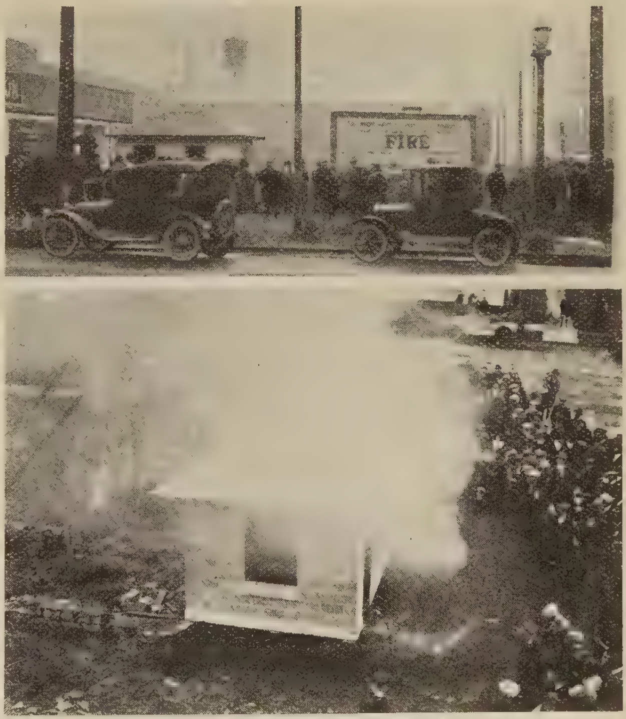
By E. W. Dienhart

Portland Cement Association

Fourteen concrete block manufacturers of Minneapolis and St. Paul put on a demonstration which went a long way to establish to the Twin Cities the fire resistance value of concrete block. They erected an attractive concrete block building midway between the two cities, and invited the State Fire Marshal and the Fire Chiefs of both cities to try to burn it down.

The test was contributed to Fire Prevention Week, for the purpose of showing the public that the surest way to prevent property destruction and loss of life through fires is to build *firesafe*. That the demonstration was successful is attested by letters of the State Fire Marshal of Minnesota and the Chief Inspector in charge of the St. Paul Fire Prevention Bureau. Both of these officials, as well as the Fire Chiefs of both cities and the leading civic organizations, cooperated actively in the attempted destruction of the building.

The building was erected on University avenue, the principal thoroughfare between Minneapolis and St. Paul. Thousands of persons watched the progress of erecting the building during the two weeks previous to the fire; their attention being attracted by the large display sign erected alongside of the building. The sign stated the purpose of the building, as well as the time and date of the fire and the names of the firms supporting the test. Five thousand printed invitations were distributed to all contractors, architects and builders, and advertisements were carried in the four leading newspapers on Friday night and Saturday morning, just previous to the fire.



Figs. 1 and 2—Concrete Block Fire Test of St. Paul and Minneapolis Producers

The day of the fire was cold and rainy, but a good crowd of interested persons was on hand to witness the test. Many public officials were there, including Fire Chief Ringer, of Minneapolis, and Fire Chief Niles, of St. Paul, as well as members of the Building Departments, Bureau of Public Safety, and representatives of the various civic associations and many contractors and architects.

Promptly at the appointed hour State Fire Marshal

Geo. H. Nettleton applied the torch to the oil-soaked wood, straw and tar paper with which the building had been filled. After heavily smoking for five minutes the flames made their way through the wooden door and window frames. Encouraged by the draft provided for by leaving openings in the lower part of the rear walls, the fire gained rapid headway and in a few minutes assumed the proportions of a veritable blast furnace. Intense heat developed immediately, and the flames burst through the door and windows and severely attacked the cornice and the roof. The cornice was fireproofed by covering the wooden rafters with expanded metal lath and stucco. The roof was covered with cement-asbestos shingles. This feature proved itself necessary to the fire safeness of any building. Even though the walls of a building be fireproof and a fireproof roofing material is used, unless the cornice is protected the flames will break through the windows and eat under the rafters and back into the building. The advantage of using metal sash with wire glass was demonstrated by the one Trus-Con steel sash that was built into the structure. While the flames destroyed the two wooden frames and sash, and caused the ordinary glass in them to buckle and practically melt, the steel sash remained in position, and though the wireglass cracked into thousands of pieces, the wire held the glass in place until the force of the fire hose was directed against it.

STATE OF MINNESOTA
Office of Fire Marshal
St. Paul, Minn.

November 4, 1922.

Concrete Products Association of Minnesota,
126 South Ninth Street,
Minneapolis, Minn.

Gentlemen:

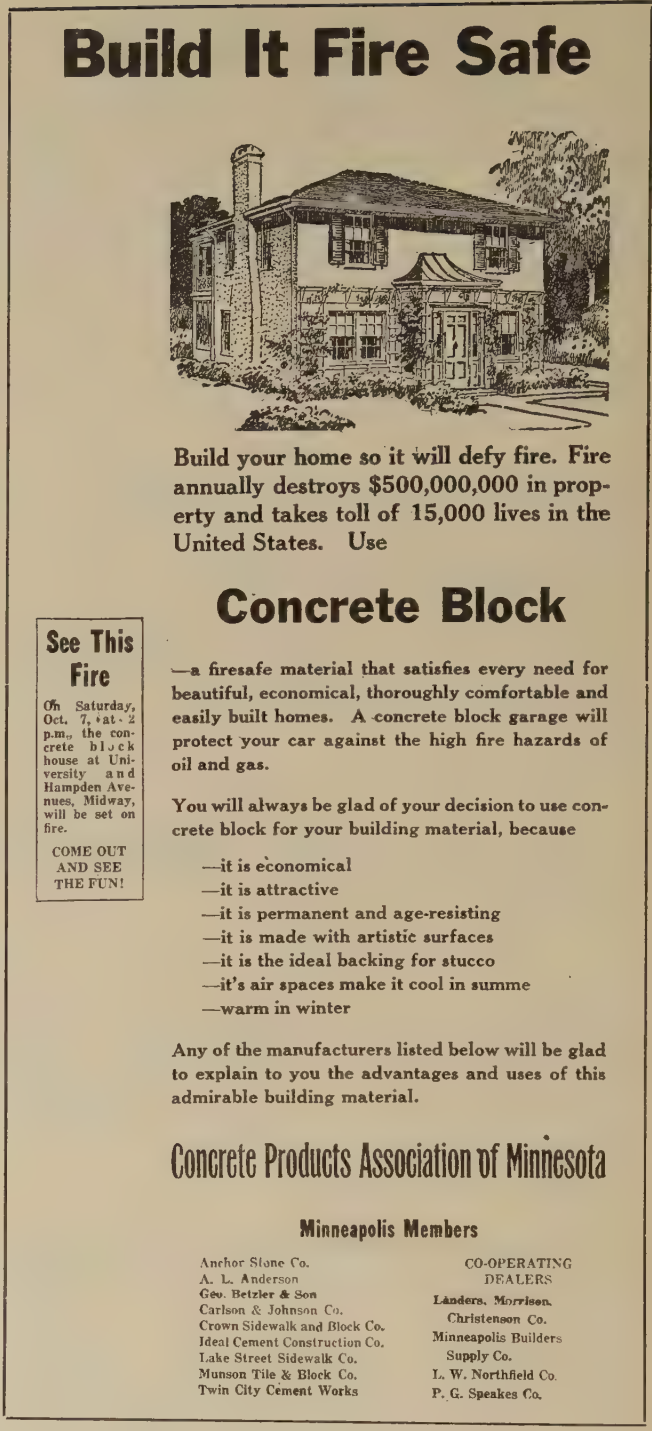
On October 7 I had the pleasure of witnessing a demonstration of the fire resistive qualities of concrete block construction in the structure erected on University Avenue at Hampden, in this city. In fact, I had the honor of applying the torch that officially started the attempted destruction of the building.

The material used performed so well throughout the test that I am prompted to write you expressing my satisfaction. It was especially surprising and pleasing in view of the unusual combination of circumstances, concrete block walls being only 10 days old and the portland cement ceiling and the exterior cement stucco only 3 days old being subjected to the intense heat generated by the oil soaked kindling fire, which was forced by an unnatural draft on account of the openings at the base of the building, to note that the superheated walls would withstand the full force of a hose line with apparently no ill effects.

It is with pleasure I endorse the use of concrete block walls, portland cement interior plaster on wire lath, with wire glass in metal sash, and the cement asbestos shingles, where fire resistive construction is desired. The value of the recommendation of the National Board of Fire Underwriters in advocating the continuation of the stucco under the eaves to meet the fireproof shingles has been fully proven.

The members of your Association are to be commended upon their contribution to the success of Fire Prevention Week in the Twin Cities. The confidence which they had in their own products was fairly substantiated through this test.

Very sincerely yours,
(Signed) George H. Nettleton,
State Fire Marshal.



Build It Fire Safe

Build your home so it will defy fire. Fire annually destroys $500,000,000 in property and takes toll of 15,000 lives in the United States. Use

Concrete Block

—a firesafe material that satisfies every need for beautiful, economical, thoroughly comfortable and easily built homes. A concrete block garage will protect your car against the high fire hazards of oil and gas.

You will always be glad of your decision to use concrete block for your building material, because

—it is economical
—it is attractive
—it is permanent and age-resisting
—it is made with artistic surfaces
—it is the ideal backing for stucco
—it's air spaces make it cool in summe
—warm in winter

Any of the manufacturers listed below will be glad to explain to you the advantages and uses of this admirable building material.

See This Fire

On Saturday, Oct. 7, at 2 p.m., the concrete block house at University and Hampden Avenues, Midway, will be set on fire.

COME OUT AND SEE THE FUN!

Concrete Products Association of Minnesota

Minneapolis Members

Anchor Stone Co.
A. L. Anderson
Geo. Betzler & Son
Carlson & Johnson Co.
Crown Sidewalk and Block Co.
Ideal Cement Construction Co.
Lake Street Sidewalk Co.
Munson Tile & Block Co.
Twin City Cement Works

CO-OPERATING DEALERS
Landers, Morrison, Christenson Co.
Minneapolis Builders Supply Co.
L. W. Northfield Co.
P. G. Speakes Co.

Fig. 3—The Kind of Newspaper Advertising Used

Immediately after the start of the fire an alarm brought two companies of motor apparatus to the scene, the firemen arranged their hose and waited for the word to put out the blaze. After burning intensely for about 30 minutes, Chief Niles gave the order, and the firemen stuck the hose nozzle into a window and applied the full force of the stream directly to the interior face of the block. A cloud of steam came through the openings and the fire was extinguished after tons of water had been played on the walls and burning material. After the severe test of a heavy stream of cold water under engine pressure applied to the extremely hot walls from a distance of only ten feet, close inspection of the interior disclosed the fact that not a single crack was in evidence in either the block or the concrete sills and lintels. The portland cement plaster on expanded metal lath ceiling prevented the fire reaching the wooden roof framing.

In the opinion of the public officials who witnessed the demonstration, the test was quite remarkable. The experienced fire fighters fully expected the walls to crack and crumble when the cold water was applied, and they were very favorably impressed with the performance of the concrete block walls when they withstood the intense fire, characterized by Chief Niles as "hotter than any similar fire could possibly be within the city limits before the fire department got into action and subdued it." When it is considered that the walls were only ten days old and the stucco and plaster only three days old, the results of this demonstration are significant.

The newspapers of both cities gave considerable publicity to the demonstration in their news columns. This activity on the part of the progressive block manufacturers and cement dealers who cooperated in this event did more than establish that concrete construction is the best barrier to fire. It brought home to the general public the sound structural qualities of well-made concrete block. Cement asbestos shingles used on this building were supplied by the Asbestos Shingle, Slate and Sheathing Co., through their factory branch in Minneapolis. Prepared portland cement stucco and plaster was applied by the Spears-Jevne Co., Minneapolis, distributors of Stonekote. The Trus-Con Steel Co. furnished the expanded metal lath and steel sash.

The Concrete Products Association of Minneapolis, under whose auspices the demonstration was conducted, has launched a campaign for more concrete block houses. The Twin City members of this organization are outlining an extensive program of promotion, which will put the advantages of concrete block construction prominently before the builders of that section.

CITY OF SAINT PAUL
Department of Public Safety
Bureau of Fire Protection
Division of Fire Prevention

October 20, 1922.

Concrete Products Ass'n of Minnesota,
126 South Ninth Street,
Minneapolis, Minnesota.

Gentlemen:

On Saturday, October 7, I was invited by Mr. E. W. Dienhart, of the Portland Cement Association, to witness the burning of a house constructed of cement blocks and stuccoed. This building was 10 ft. wide by 14 ft. long by 9 ft. high and was constructed as follows:

8-in. concrete block walls.
1 metal sash—wire glass.
2 wooden frames and sash—ordinary glass.
1 wooden door and frame.
Concrete sills—concrete lintels.
2 by 4 wood rafters and ceiling joist—tight board roof.
Cement-asbestos shingles.
soffits of eaves covered with metal lath and stucco brought around from walls to shingles.
Ceiling, metal lath with ¾ in. of cement plaster.
Stucco, portland cement.
All plaster only 3 days old.
Concrete block walls ten days old.

This building was filled with slab wood and four or five gallons of kerosene oil poured on the wood. A match was touched to it by State Fire Marshalll Mr. Nettleton, at 2:15 P. M., and it was allowed to burn for thirty minutes, when the Fire Department put out the fire. By that time a very hot fire was raging and the window frame and doorway were burned.

The fire did not burn through the plaster on the ceiling, the roof not being damaged at all. After the fire the building walls were in as good shape as before, and the only parts of the building which were damaged at all were the door and window frames, which were of wood. Was quite surprised to see how well the walls held after the Fire Department had put on a stream of water with engine pressure.

In view of the splendid way in which this building withstood this fire, I can enthusiastically recommend such construction as put out by the Concrete Products Association of Minnesota to guard against a total loss in case of fire in a residence.

Yours very truly,
(Signed) William Barron,
Chief Inspector.

Polished Marble and Granite Concrete

Very beautiful examples of polished marble and granite concrete have been received by Concrete from Julius Ruoff, Philadelphia. Mr. Ruoff has specialized in ornamental work in the concrete products line and has built up a good business in concrete porches, which have previously been the subject of comment in these pages. In writing of his recent work which he proposes to turn to special advantage in making precast steps and other trim features, Mr. Ruoff says.

"The polish will wear inside as long as marble polish, but in warm climate like California, will be good for outside work also. For inside work, it will be better than marble or grante as this work will be fireproof and has the same advantage as first class concrete work.

The coloring of this work goes through the whole interior and will make when tooldressed, without polish, a fine stone effect. The mixture of the facing is 1 part of cement, 2½ parts of screenings from dust to ¼ in. size, according to texture. After the work is out of the molding for a few days it will be ground off, to take the cement off from the surface, washed off with clean water and the holes closed up with the mixture of the stone like that in the original cast, only the material passing through a fine sieve, to obtain the same color of the stone.

The surface is then treated with a solution of Kessler fluates, which makes the surface very hard. After a week the stone can ground with a carborandum stone. Then the little holes again have to be closed up with some fine mixture and after the concrete is hard enough it has to be ground with a finer carborandum stone, until the surface is smooth. It is then polished with rough linen or felt by adding a little putty or zinc powder and fluates. It takes of course some experience to get a high class polish.

"The crushed stone used for marble finish will be a mixture of Kapallo marble chips from Tuckahoe in sizes X, 4, 5 and 7, or what they call run of crusher, which is all the sizes from dust to number 9. Fine polishing putty, which is beinb used in marble yards and can also be used for polishing. I am using a few drops of Kessler fluates with the polishing putty."

Causes of Cracks and Disintegration

That the causes of cracks and disintegration of concrete are very numerous, not well defined and in many cases not understood, are the conclusions drawn as a result of investigation conducted in England, described in *Concrete and Constructional Engineering*. In explaining the probable causes sometimes involved, they are placed under four groups, (1) composition and physical state of the cement as received, (2) misuse of the cement, (3) composition and physical state of the aggregate employed, and (4) conditions to which concrete is exposed. By far the greater number of failures are attributed to faulty workmanship, or the conditions to which the work is exposed, and only a few are traced to bad material.

The Index to Concrete, Vol. 21, July to December, 1922, will be published in January and sent to all subscribers who ask for it.

Our Foreign Contemporaries

By E. Lee Heidenreich

Concrete Hoisting Towers for Mine Shafts

An idea of the interesting details and problems solved in the design of concrete hoisting towers and inclines for mine shafts may be had by examining the accompanying illustrations published in connection with a series of articles by Dr. F. Koegler in *Beton und Eisen.*

Owing to lack of space a mere digest cannot give any of the many interesting details, and for these the readers must be referred to the original articles in *Beton und Eisen.* However, an idea of the remarkable problems solved may be had by examining a few of the photographs, perspectives, plans and sections which profusely accompany the articles.

Thus Fig. 1 shows two sectional views of the tower for Franz-Joseph shaft of the Donau-Dampfschiffahrt-Gesellschaft at Funfkirchen, Hungary. To the right of Fig. 1 is shown a perspective view of the hoisting tower at Elwerath in Haenigsen, both designs giving an idea of the careful calculations required and the economical considerations inspiring the designer.

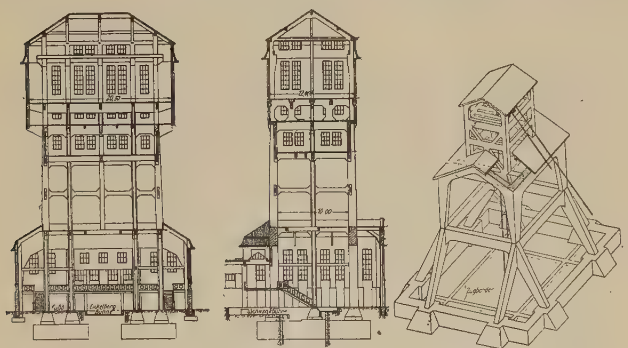


Fig. 1—Sections and Perspective View of Concrete Hoisting Towers for Mine Shafts

Dr. Koegler, in his first installment, calls attention to the general requirements of the mine tower and incline construction, the heavy loads to be hoisted by means of electrical machinery located at a great height above the ground, causing principally vertical stresses, while incline hoists have the stresses running at all angles. The height and width of the towers or inclines cannot often be according to statical requirements, but depend on local conditions.

The firm of Carl Brandt, Duesseldorf, was the first to design these towers and inclines in reinforced concrete. Dr. Mautner, of this firm, has desighed such structures at Camphausen, Kleinschierstedt, Oslawan and Funfkerchen, the latter shown in the accompanying figure.

San Thelmo Bridge Over Guadalquivir, in Sevilla

Prof. J. Eugenio Ribera, Madrid, in *Beton und Eisen*

The illustration (Fig. 2) shows an exceptionally attractive concrete bridge of two 150-ft. spans and one of 165 ft., of Scherzer construction.

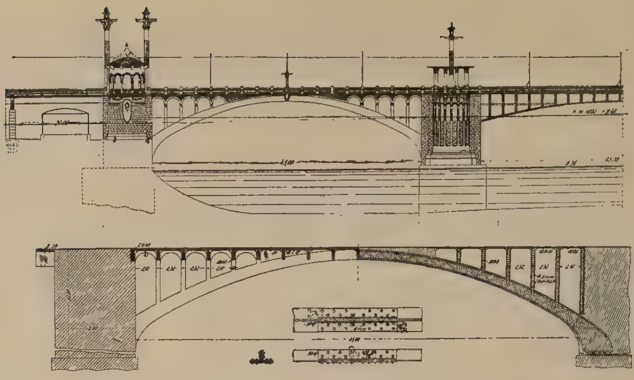


Fig. 2—Bridge Erected Without Scaffolding

The bridge was erected without the use of any other scaffold than the one suspended from the steel core or reinforcement, this arch being strong enough to support the wet concrete. The traffic and heavy current of the Gaudalquivir was such that no other scaffold was permissible, and hence this design by Prof. Ribera was accepted.

Fig. 2 shows the steel arch construction used primarily to support the formwork, and acting as reinforcement for the finished bridge.

Concrete Block School House, Roswell, N. M.

The picture shows a concrete block school house at Roswell, N. M., built by Henry J. Kranz. Mr. Kranz says he makes a concrete block 8 in. by 8 in. by 16 in. with the standard air space, on a machine of his own manufacture.

> I use clean gravel (if not clean as it comes) I wash size that goes through a 1 in. mesh screen and retained on a ¼ in. mesh, use two grades of sand, coarse and fine, to have the least amount of voids, and by water test I determine the amount of cement. This material is mixed quite wet so it will quake when tamped in machine. The machine is made so that the block on the pallet is pushed out of the mold. This makes as near waterproof block I think as can be made. With gravel and sand costing about $3.00 per yard and cement averaging $1.10 per sack, labor $2.50 per day the block cost 20 cents a piece or about 40 cents laid up in the wall including mortar. This makes a cheaper wall than any other material of the same value, as the walls are ready for plastering inside and outside if wanted. (The practice of plastering direct on block walls is not to be generall recommended.—Editor) I cast a reinforced concrete watertable and also a reinforced concrete course all around the building over the windows, by doing this I have no trouble with any cracks. Of course I see to it that I have a good foundation. What we have to contend with here is expansion and contraction on account of sudden changes in temperature. My greatest worry is to get the blocks laid right. A brick mason is no good and a stone mason is worse. The only way I can get them laid to suit me is to break in a laborer.

Concrete Block School at Roswell, N. M.

The Design of Flat Slab Floors

Based on the Detroit Building Code Rulings

By Stanley T. Mills

Although it is less than 20 years since the first flat-slab building was erected, the advantages of this system of construction have been so apparent that at the present time it has nearly superceded the beam and girder type for buildings to which it is suited.

Three conditions are necessary for the most economical use of a flat-slab floor. They are:

1. A fairly uniform superposed load of at least 100 lbs. per sq. ft.
2. An arrangement of columns that will form panels of nearly uniform size and nearly square.
3. Few large openings in the floor.

In the design of a factory, warehouse, garage, or other building in which the above conditions are fulfilled, flat-slab construction simplifies the form work, saves story height, due to the absence of deep beams; gives a flat ceiling, thus securing better light, and simplifying the steam and sprinkler systems; and forms a tough floor that is not liable to sudden failure.

No method has been developed for the theoretical analysis of the action of flat-slab floors under load, and all methods of design now in use are based on experimental data. Several cities have adopted rules governing this type of design, and in the majority of cases these rules represent conservative engineering practice. The rules adopted by the city of Detroit appear to possess the good features of most other city codes, plus greater simplicity, especially as regards the 4-way system of reinforcing. While the majority of other city codes specify the moments to be resisted by certain sections of the panel, the Detroit code states the moments that are to be resisted by certain bands of reinforcing, thus eliminating one step in the computations.

Although giving a slightly different distribution of moments, the total strength required by the Detroit code agrees closely with other recent rulings, as can be seen from the following comparison:

Let *M* equal the sum of the negative and positive moments to be resisted in one direction across the panel.

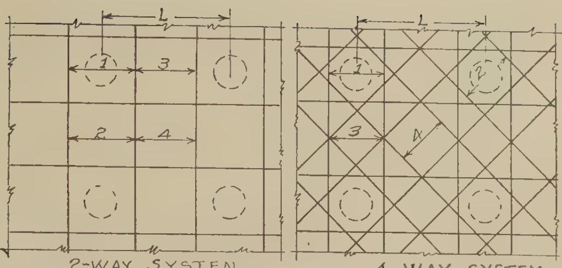
W equals the total weight of dead and live load on the panel.

L equals the distance, center to center, of columns for a square, interior panel.

Authority	Moment Resisted
American Concrete Institute, 1917 ruling..	*M* equals .065 *WL* (approx.)
New York City, 1920........................	*M* equals .059 *WL*
Detroit code	*M* equals .064 *WL*

In the actual design of flat-slab buildings many special problems will naturally present themselves, such as concentrated loads, openings in the slab, irregularly shaped panels, etc. No attempt will be made here to touch upon these features, for only a careful analysis of each problem will suffice in such cases. The material here presented comprises only the rules of the Detroit Building Code, in modified form, together with a few recommendations of the American Concrete Institute, and other recognized authority.

The tables and chart will be found especially useful for rapid comparison between different designs for a building, and for actual design where no unusual conditions are present. An example is appended, illustrating the use of the tables in the case of a square, interior panel. Exterior and rectangular panels may be calculated from the rules given in the text.



2-WAY SYSTEM

Band	Moment Resisted
No. 1. Main	−WL÷32
2. Main	+WL÷64
3. Intermediate	−WL÷128
4. Intermediate	+WL÷128

4-WAY SYSTEM

Band	Moment Resisted
No 1. Direct	−WL÷60
2. Diagonal	−WL÷60
3. Direct	+WL÷100
4 Diagonal	+WL÷100

Fig. 1—Two-Way and Four-Way Systems for Interior Panels

To Design a Square Interior Panel

From the table opposite the given span find:
Diameter of column cap, *C*
Width of drop panel, *D*

Under the given superposed load per square foot, find:
Thickness of slab, *t*
Thickness of drop panel, *T*

Assume a depth to center of steel for the slab, usually t-(r+¾ in.), where r is the diameter of a reinforcing rod.

Enter chart at bottom at given span, center to center of columns; follow vertically to given superposed load; thence horizontally to assumed effective depth of slab; thence vertically to top of chart, and read the areas of steel for the required bands.

If it is desired to use the minimum thickness for the drop panel, assume a depth to center of steel over the column, usually T-($2r$+ ¾ in.), and repeat as above to get the area of negative steel, using the effective depth of the drop panel instead of slab.

The thicknesses of drop panels here given are minimum values. In many cases, especially under heavy loadings, a thicker drop panel, with a corresponding reduction in negative steel is recommended. A thicker drop reduces the shear around the column head, an especially desirable feature where live loads are apt to be heavily concentrated.

A procedure that will simplify construction, but add slightly to the quantity of concrete, is as follows (this applies to the 4-way system only):

As the negative moment of each band over the column head is 1/60 *WL*, and the positive moment of each band between columns is 1/100 *WL*, if the effective depth of the drop panel is made 100/60, or 1⅔ that in the slab, the steel needed will be the same in both places, and every alternate bar in all bands in the slab may be bent up to extend over the column head.

In the 4-way system the width of one band of reinforcing is given in the table under column *B*. In the 2-way system the width of a band is .5*L*.

Select from the diagram at the right of the chart a size of rod that will give a spacing of from 5 in. to 10 in., depending on the slab thickness. (Intermediate bands, 2-way system use 8 in. to 12 in.).

See notes on "Arrangement and Distribution of Steel" for details.

Note—The following tables are based on a steel stress of 18,000 lbs. per sq. in. The Detroit Code allows a stress of 20,000 lbs. for hard deformed bars, but this practice is not recommended.

To Design a Rectangular Panel

The long side must not be over one and one-fourth times the short side.

If the long side is not over 5% longer than the short side, all dimensions, areas of steel, moments, etc., are computed the same as for a square panel of equal area.

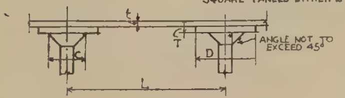
In rectangular panels, dimensions *C, D, t,* and *T* are the same as for a square panel of equal area.

The widths of bands of reinforcing, 4-way system may be made as follows:

FLAT SLAB DESIGN

DETROIT BUILDING CODE

SQUARE PANELS EITHER 2 OR 4 WAY SYSTEMS.



$t = .02\,L\sqrt{w} + 1''$ MINIMUM 6"
$T = .0265\,L\sqrt{w} + 1\frac{1}{2}$ MINIMUM DROP 2"
C = .225 L
D = .375 L FOR DEPRESSED PANELS.
D = .5 L FOR RAISED PANELS
L = CENTER TO CENTER OF COLS. FOR SQUARE. PANELS OR IN CASE OF RECTANGULAR PANELS SIDE OF SQUARE OF EQUAL AREA LONG SIDE OF RECTANGULAR PANELS NOT OVER 1¼ TIMES SHORT SIDE
MINIMUM $t = \frac{1}{32}L$ FOR FLOORS AND $\frac{1}{40}L$ FOR ROOFS.

MAXIMUM $f_c = 750\#/\text{in.}^2$

w = TOTAL DEAD AND LIVE LOAD PER SQUARE FOOT OF FLOOR.
W = " " " " " " PANEL INCLUDING DROP PANEL
M = W·L
B = WIDTH OF ONE BAND OF REINFORCING = .414 L
WB = PROJECTION OF WALL BRACKET = $\frac{1}{15}$ L WHERE BRACKET IS 2½" DEEP.

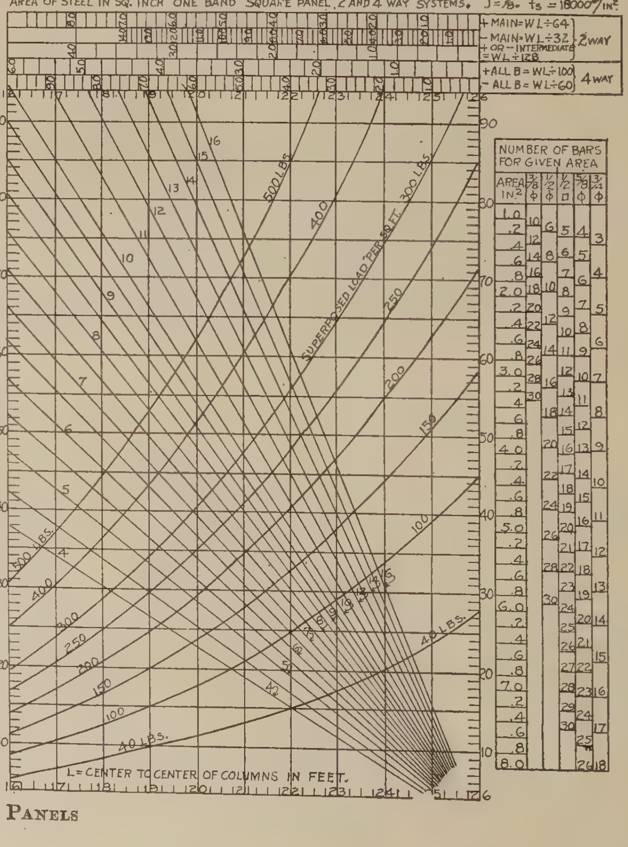
DIMENSIONS WEIGHTS MOMENTS :- w IN LBS, W IN THOUSANDS OF LBS M IN MILLIONS OF INCH LBS

	DIMENSIONS						TOTAL SUPERPOSED LOADS PER SQUARE FOOT.									
L	AREA	C	D	B	WB		40	100	150	200	250	300	400	500		L
14'0"	196	3'2"	5'3"	70"	12"	t	6"	6"	6"	6"	6¼"	6½"	7¼"	8"	t	14'0"
						T	6"	8"	8"	8"	8¼"	8¾"	9¾"	10¾"	T	
						w	115	175	225	275	328	381	491	600	w	
						W	22.6	35.0	44.9	54.5	65.0	75.5	97.2	118.7	W	
						M	3.8	5.88	7.55	9.16	10.9	12.7	16.3	19.9	M	
14'6"	210	3'4"	5'6"	72"	12"	t	6"	6"	6"	6"	6¼"	6¾"	7½"	8¼"	t	14'6"
						T	6"	8"	8"	8"	8½"	9¼"	10¼"	11"	T	
						w	115	175	225	275	328	385	494	603	w	
						W	24.2	37.6	48.1	58.5	69.7	81.8	104.9	127.8	W	
						M	4.22	6.55	8.37	10.18	12.12	14.23	18.25	22.25	M	
15'0"	225	3'5"	5'8"	75"	12"	t	6"	6"	6"	6"	6½"	7"	7¾"	7½"	t	15'0"
						T	6"	8"	8"	8¼"	8¾"	9½"	10½"	11½"	T	
						w	115	175	225	275	331	388	497	606	w	
						W	25.9	40.2	51.5	62.8	75.4	88.4	112.9	138.1	W	
						M	4.67	7.24	9.27	11.3	13.6	15.9	20.3	24.9	M	
15'6"	240	3'6"	5'10"	77"	13"	t	6"	6"	6"	6¼"	6¾"	7¼"	8"	8¾"	t	15'6"
						T	6"	8"	8"	8½"	9¼"	9¾"	10¾"	11¾"	T	
						w	115	175	225	278	335	391	500	610	w	
						W	27.6	42.8	54.8	67.7	81.6	95.0	121.2	147.8	W	
						M	5.13	7.96	10.2	12.6	15.2	17.7	22.5	27.5	M	
16'0"	256	3'8"	6'0"	79"	13"	t	6"	6"	6"	6½"	7"	7½"	8½"	9"	t	16'0"
						T	8"	8"	8"	8¾"	9½"	10"	11¼"	12"	T	
						w	115	175	225	281	338	394	506	612	w	
						W	30.4	45.5	58.6	73.0	87.7	102.1	130.8	158.4	W	
						M	5.83	8.74	11.25	14.0	16.85	19.6	25.1	30.4	M	
16'6"	272	3'9"	6'3"	82"	[illegible]	t	6"	6"	6"	6¾"	7¼"	7¾"	8¾"	9¼"	t	16'6"
						T	8"	8"	8¼"	9"	9¾"	10¼"	11½"	12½"	T	
						w	115	175	225	285	341	397	510	616	w	
						W	32.3	48.7	62.4	78.6	94.0	109.2	140.0	169.1	W	
						M	6.4	9.67	12.37	15.57	18.6	21.6	27.7	33.5	M	
17'0"	289	3'10"	6'5"	84"	14	t	6"	6"	6¼"	6¾"	7½"	8"	8¾"	9½"	t	17'0"
						T	8"	8"	8½"	9¼"	10"	10¾"	11¾"	12¾"	T	
						w	115	175	228	285	344	400	510	619	w	
						W	34.2	51.6	66.1	83.6	100.8	117.0	148.9	180.6	W	
						M	6.98	10.5	13.5	17.05	20.5	23.9	30.4	36.8	M	
17'6"	306	4'0"	6'7"	87"	14"	t	6"	6"	6½"	7"	7½"	8"	9"	9¾"	t	17'6"
						T	8"	8"	8¾"	9½"	10¼"	11"	12¼"	13¼"	T	
						w	115	175	231	288	344	400	513	622	w	
						W	36.3	54.7	71.9	89.5	106.8	124.1	158.8	192.1	W	
						M	7.63	11.5	15.1	18.8	22.4	26.1	33.3	40.5	M	
18'0"	324	4'1"	6'9"	89"	15"	t	6"	6"	6½"	7¼"	7¾"	8¼"	9¼"	10"	t	18'0"
						T	8"	8"	8¾"	9¾"	10½"	11¼"	12½"	13½"	T	
						w	115	175	231	291	347	403	516	625	w	
						W	38.5	57.9	76.2	95.8	114.1	132.4	168.9	204.5	W	
						M	8.32	12.5	16.45	20.7	24.7	28.6	36.5	44.2	M	
18'6"	342	4'2"	6'11"	92	15"	t	6"	6"	6¾"	7½"	8"	8½"	9½"	10½"	t	18'6"
						T	8"	8"	9"	10"	10¾"	11½"	12¾"	14"	T	
						w	115	175	235	294	350	406	519	632	w	
						W	40.5	61.0	81.7	102.0	121.4	140.5	179.5	218.3	W	
						M	9.0	13.55	18.1	22.4	27.0	31.2	39.8	48.5	M	
19'0"	361	4'4"	7'2"	94"	16"	t	6"	6¼"	7"	7¾"	8¼"	8¾"	9¾"	10¾"	t	19'0"
						T	8"	8¼"	9¼"	10¼"	11"	11¾"	13"	14¼"	T	
						w	115	178	238	297	353	410	522	635	w	
						W	42.8	65.6	87.4	108.8	129.2	149.9	190.5	231.2	W	
						M	9.75	14.95	19.9	24.8	29.5	34.2	43.4	52.7	M	
19'6"	380	4'5"	7'4"	97"	16"	t	6"	6¼"	7¼"	7¾"	8½"	9"	10"	11"	t	19'6"
						T	8"	8½"	9½"	10½"	11¼"	12"	13¼"	14½"	T	
						w	115	178	241	297	356	413	525	638	w	
						W	45.1	69.2	93.1	114.7	136.0	158.1	200.7	243.9	W	
						M	10.55	16.2	21.8	26.9	31.8	37.0	47.0	57.0	M	
20'0"	400	4'6"	7'6"	99"	16"	t	6"	6½"	7¼"	8"	8¾"	9¼"	10¼"	11¼"	t	20'0"
						T	8"	8¾"	9¾"	10¾"	11¾"	12½"	13¾"	15"	T	
						w	115	181	241	300	360	416	528	641	w	
						W	47.4	74.1	98.2	127.0	146.1	168.6	214.0	258.7	W	
						M	11.4	17.8	23.6	29.3	35.1	40.4	51.3	62.2	M	
20'6"	420	4'8"	7'9"	102"	17"	t	6"	6¾"	7½"	8¼"	9"	9½"	10½"	11½"	t	20'6"
						T	8"	9"	10"	11"	12"	12¾"	14"	15½"	T	
						w	115	185	244	303	363	419	532	644	w	
						W	49.8	79.5	103.2	129.4	154.7	178.2	225.6	273.3	W	
						M	12.25	19.6	25.4	31.8	38.0	43.8	55.5	67.2	M	
21'0"	441	4'9"	7'11"	104"	17"	t	6"	6¾"	7¾"	8½"	9"	9¾"	10¾"	11¾"	t	21'0"
						T	8"	9¼"	10¼"	11¼"	12¼"	13"	14½"	15¾"	T	
						w	115	185	247	306	363	422	535	647	w	
						W	52.3	82.5	110.8	137.2	162.6	188.6	239.0	288.2	W	
						M	13.2	20.8	27.9	34.6	41.0	47.5	60.3	72.7	M	
21'6"	462	4'10"	8'1"	107"	18"	t	6"	7"	7¾"	8¾"	9¼"	10"	11"	12"	t	21'6"
						T	8"	9½"	10½"	11¾"	12½"	13¼"	14¾"	16"	T	
						w	115	188	247	310	366	425	538	650	w	
						W	54.8	89.0	[illegible]	145.5	171.7	198.7	251.1	303.3	W	
						M	14.15	23.0	30.0	37.5	44.3	51.3	64.8	78.3	M	
22'0"	484	5'0"	8'3"	109"	18"	t	6"	7¼"	8"	8¾"	9½"	10¼"	11¼"	12¼"	t	22'0"
						T	8"	9¾"	10¾"	11¾"	12¾"	13¾"	15¼"	16½"	T	
						w	115	191	250	310	369	428	541	653	w	
						W	57.4	94.6	123.4	152.6	181.3	210.0	265.4	319.6	W	
						M	15.15	25.0	32.6	40.3	47.8	55.5	70.0	84.4	M	

DIMENSIONS WEIGHTS MOMENTS w IN LBS W IN THOUSANDS OF LBS, M IN MILLIONS OF INCH LBS.

	DIMENSIONS						TOTAL SUPERPOSED LOADS PER SQUARE FOOT.									
L	AREA SQ FT.	C	D	B	WB		40	100	150	200	250	300	400	500		L
22'6"	506	5'1"	8'6"	112"	18	t	6"	7¼"	8¼"	9"	9¾"	10½"	11½"	12¾"	t	22'6"
						T	8"	9¾"	11"	12¼"	13"	14"	15½"	17"	T	
						w	115	191	253	313	372	432	544	660	w	
						W	60.0	98.8	130.5	161.4	191.3	221.7	278.6	337.8	W	
						M	16.2	26.7	35.2	43.6	51.7	59.8	75.3	91.3	M	
23'0"	529	5'3"	8'8"	114"	19"	t	6"	7½"	8½"	9¼"	10"	10¾"	11¾"	13"	t	23'0"
						T	8¼"	10"	11¼"	12½"	13½"	14¼"	15¾"	17¼"	T	
						w	115	194	256	316	375	435	547	663	w	
						W	62.9	105.9	138.1	170.1	201.7	233.3	292.8	355.0	W	
						M	17.35	29.2	38.1	47.0	55.7	64.4	80.8	98.0	M	
23'6"	552	5'4"	8'10"	117"	19"	t	6¼"	7¾"	8¾"	9½"	10¼"	11"	12"	13¼"	t	23'6"
						T	8½"	10¼"	11¾"	12¾"	13¾"	14¾"	16¼"	17¾"	T	
						w	118	197	260	319	378	438	550	666	w	
						W	67.4	111.1	146.4	179.2	211.9	245.2	307.6	371.4	W	
						M	19.0	31.3	41.3	50.6	59.7	69.2	86.8	104.8	M	
24'0"	576	5'6"	9'0"	119"	20"	t	6¼"	7¾"	8¾"	9¾"	10½"	11¼"	12½"	13½"	t	24'0"
						T	8½"	10½"	11¾"	13"	14"	15"	16½"	18"	T	
						w	118	197	260	322	382	441	556	669	w	
						W	70.3	116.2	152.6	188.3	223.6	257.8	324.0	389.6	W	
						M	20.3	33.4	43.9	54.3	64.3	74.2	93.3	112.0	M	
24'6"	600	5'7"	9'2"	122"	20"	t	6½"	8"	9"	10"	10¾"	11½"	12¾"	13¾"	t	24'6"
						T	8¾"	10¾"	12¼"	13¼"	14¼"	15¼"	17"	18½"	T	
						w	121	200	263	325	385	444	560	672	w	
						W	75.3	122.9	161.2	198.4	234.7	270.9	340.4	408.0	W	
						M	22.1	36.1	47.4	58.3	69.0	79.7	100.0	120.0	M	
25'0"	625	5'8"	9'5"	124"	20"	t	6½"	8¼"	9¼"	10¼"	11"	11¾"	13"	14"	t	25'0"
						T	9"	11"	12½"	13½"	14¾"	15½"	17¼"	18¾"	T	
						w	121	203	266	328	388	447	563	675	w	
						W	78.4	130.1	169.6	208.6	246.6	283.1	356.7	427.2	W	
						M	23.5	39.0	50.9	62.7	74.0	85.0	107.0	128.0	M	
25'6"	650	5'9"	9'7"	127"	21"	t	6¾"	8½"	9½"	10¼"	11¼"	12"	13¼"	14¼"	t	25'6"
						T	9¼"	11¼"	12¾"	13¾"	15"	16"	17¾"	19¼"	T	
						w	125	206	269	328	391	450	566	678	w	
						W	84.2	137.2	178.3	216.8	258.3	297.1	373.1	446.8	W	
						M	25.8	42.0	54.6	66.3	79.2	91.0	114.0	136.5	M	
26'0"	676	5'11"	9'9"	129"	21"	t	7"	8½"	9¾"	10½"	11½"	12¼"	13½"	14¾"	t	26'0"
						T	9½"	11½"	13"	14¼"	15¼"	16¼"	18"	19¾"	T	
						w	128	206	272	332	394	453	569	685	w	
						W	89.5	142.6	187.9	228.5	270.5	310.8	390.3	469.0	W	
						M	27.9	44.5	58.7	71.4	84.4	97.0	122.0	146.5	M	
26'6"	702	6'0"	10'0"	132"	22"	t	7"	8¾"	9¾"	10¾"	11¾"	12¼"	13¾"	15"	t	26'6"
						T	9½"	11¾"	13¼"	14½"	15½"	16½"	18½"	20"	T	
						w	128	210	272	335	397	453	572	688	w	
						W	93.1	151.1	195.1	239.7	283.2	323.3	406.9	488.8	W	
						M	29.6	48.2	62.1	76.3	90.0	103.0	129.5	155.5	M	
27'0"	729	6'1"	10'2"	134"	22"	t	7¼"	9"	10"	11"	11¾"	12½"	14"	15¼"	t	27'0"
						T	9¾"	12"	13½"	14¾"	15¾"	16¾"	18¾"	20½"	T	
						w	131	213	275	338	397	456	575	691	w	
						W	98.6	159.3	205.0	251.4	294.2	337.4	425.1	458.8	W	
						M	32.0	51.6	66.5	81.4	95.4	109.5	138.0	149.0	M	

AREA OF STEEL IN SQ. INCH ONE BAND SQUARE PANEL, 2 AND 4 WAY SYSTEMS. j = ⅞. $f_s = 18000\#/\text{in}^2$



Tables and Chart for Use in Design of Square Interior Panels

Long direct bands, same width as for a square panel having side equal to the short dimension.

Short direct bands, same width as for a square panel having side equal to the long dimension.

Diagonal bands, same width as for square panel of equal area.

Steel areas, 4-way system

Long direct bands, steel area equal to that for square panel with sides equal to the long dimension.

Short direct bands, steel area equal to that for square panel with sides equal to the short dimension.

Diagonal bands, steel area equal to that for square panel of equal area.

Steel areas, 2-way system

Long main bands, steel area equal to that for square panel with sides equal to long dimension.

Short main bands, steel area equal to that for square panel with sides equal to short dimension, but not less than two-thirds that of long bands.

Long intermediate bands, steel area equal to that for square panel, with sides equal to short dimension, but not less than two-thirds that in short intermediate bands.

Short intermediate bands, steel area equal to that for square panel with sides equal to long dimension.

To Design an Exterior Panel

Bands not continuous at one end to be designed for 25% more positive moment than if continuous at both ends. Increase steel accordingly, but if this overstresses the concrete, use thicker slab or shorter span.

Negative moments at wall line in bands perpendicular to edge of slab, two-thirds of that for similar interior panel.

Negative moments at wall line in diagonal bands, five-sixths that for similar interior panels.

At least one-half as much steel in bottom of slab as there is in top in these directions.

Spandrel wall beams to carry one-sixth of total panel load (1/6 *W*) in addition to wall, etc., above. Make spandrel beams nearly square, to resist torsion. If beams are exposed to weather, use temperature steel near outside surface.

No drop panel at exterior columns. Substitute a 45° bracket, same width as face of column, and projecting distance *WB* in tables.

Half main band parallel to wall, same as half main band in interior panel.

Where slab is only two bays wide, increase negative moments in direct bands across line of interior columns 15%, and in diagonal bands 7%. Check concrete stresses and increase thickness if necessary.

Arrangement and Distribution of Steel

Point of inflection in main and diagonal bands assume to be one-fifth of clear span between edges of column capitals out from column capitals. Point of inflection for intermediate bands, 2-way system, one-sixth of total span out from center line of columns.

All bars to extend at least to point of inflection and at least one-half of bars not bent to extend 30 diameters beyond point of inflection.

At least one-half of top bars over columns to be bent down at or near point of inflection and to extend out as positive reinforcement.

All bars in exterior panels to be bent or hooked into columns or spandrels. Bottom bars to have a bearing of at least 6 in. on spandrels or columns.

Bars spliced by lapping and counted as one bar to be lapped at least 80 diameters, if splice is made at point of maximum stress, and not over one-half of the bars in any one band to be so spliced.

Continuous bars should not all be bent up at the same point, but should be staggered each side of the point of inflection.

Concrete Stresses

The usual theory of internal stresses in concrete is used. Over column cap, where four bands of reinforcing intersect (4-way system), the maximum direct compressive stress is twice that caused by one band alone.

An increase of 10% in compressive stress over the columns is allowable.

The following stresses are recommended:

Steel, usual run of good deformed bars, 18,000 lbs. per sq. in. 1:2:4 concrete, extreme fiber in bending, 700 lbs. per sq. in.

(With the thicknesses of slabs and drop panels as given, the maximum concrete stresses are not over 700 lbs. per sq. in., except in some cases over the columns, where the 10% is allowed.)

Shear in concrete not reinforced against diagonal tension, 40 lbs. per sq. in.

Shear, where properly reinforced, 120 lbs. per sq. in.

Bearing on surface at least twice loaded area, 800 lbs. per sq. in.

Openings and Concentrated Loads

Any opening over .2*L* to be framed with concrete beams. If less than three-fourths of the bars in a panel can occupy their natural positions, do not design as a flat-slab. No openings in main reinforcing bands over 1/15*L*. Place extra bars around small openings.

Beams around openings should be figured to carry their share of the floor load, in addition to any concentrations.

Heavy concentrated loads should be provided for by beams, preferably made wide and shallow to allow a flexibility comparable with that of the slab.

Columns Supporting Flat Slabs

Value *W* in the tables (= total dead and live load on a panel) will be useful in calculating column loads.

Least dimension of any column, 1/15*L*, minimum to be 16 in. Columns carrying flat slab on one side only shall resist a moment of *WL*/70, in addition to its direct load, if the column continues past the floor.

If the column stops at the floor, it must resist *WL*/35. Corner columns to resist one-half of these moments in each direction. Stresses from moments not to be over one-half the direct stress.

Columns with unequal spans on opposite sides, to be designed to carry the difference in moment over the column cap, in addition to the direct stress, this moment to be divided between the columns above and below the floor in proportion to their stiffness.

Four ¾-in. round rods to be the minimum reinforcement.

Example

To design a square, interior panel, 4-way system:
Total superposed load, 150 lbs. per sq. ft.
Center to center of columns, 21 ft.
From table, opposite *L*- 21 ft. find:
Diameter of column cap *C* = 4 ft. 9 in.
Width of drop panel *D* = 7 ft. 11 in.
Width of band of reinforcing *B* = 104 in.
Under 150 lbs. per sq. ft. find:
Thickness of slab *t* = 7¾ in.
Thickness of drop panel T = 10¼ in. (minimum).

Assume an effective depth for slab to center of steel = *t* - 1¼ in. = 6½ in.

Enter chart, at bottom, at *L* = 21 ft.; follow vertically to curve (load 150 lbs. per sq. ft.); thence horizontally to diagonal line (d - 6½ in.); thence vertically to top of chart. Opposite $\left(-All\ B = \frac{WL}{4} \div 100\right)$ read area of steel required for bands 3 and 4. This equals 2.7 sq. in. From table of bar areas at side of chart find 14 ½-in. round bars will finve the required area.

As one band of reinforcing is 104 in. wide, the spacing will be 104 ÷ 13 = 8 in., which is satisfactory.

If it is desired to use the same area of steel over the column cap, the effective depth of the drop panel must be 100/60 of 6½ in. = 10¾ in., and the total depth will be 10¾ in. + 1¾ in. = 12½ in., or a drop of 4¾ in.

If for any reason the drop must be made less, and it is certain that the assumed superposed load will amply provide for any concentrations causing heavy shear near the columns, then the drop panel may be made the minimum thickness given in the table, or 10¼ in., and the effective depth will be 8½ in.

To find the negative steel area in this case, enter the chart at (L = 21 ft.); vertically to (Load = 150 lbs.); horizontally to (d = 8½ in.); vertically to top of chart. Opposite ($-All\ B = WL \div 60$), read area required for bands 1 and 2, or 3.4 sq. in. In the table, find 18 ½-in. round rods will be sufficient, giving a spacing of 6 in.

Flat Slab Structure Carries Track Elevation

By A. W. Newton,

Chief Engineer, Chicago, Burlington & Quincy R. R.

In connection with track elevation work in the city of Aurora, Ill., for the Chicago, Burlington & Quincy Railroad, the elevation is carried for about four blocks in the heart of the city on a concrete structure, the open space beneath the tracks being practically unobstructed and allowing traffic to pass to the sections of the city on either side.

The fourway reinforced concrete structure is designed for Cooper's E-65 loading on each track. As the track centers are 14 ft. it was considered that the load might not act over the entire width of 14 ft. and the live load and impact were therefore reduced to a uniform load of 1675 lbs. per sq. ft. for use in designing the slab.

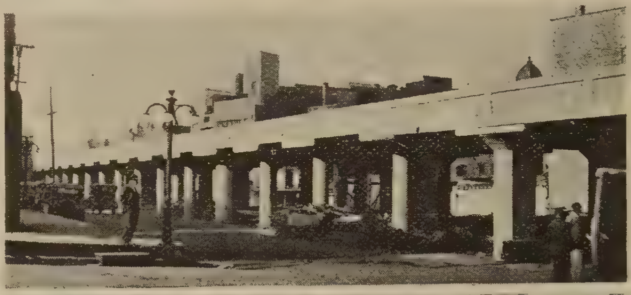
The main structure, as shown in the accompanying illustrations, is 44 ft. 6 in. wide and is about 1420 ft. long, resting on three rows of columns with a transverse spacing of 18 ft. and having 4 ft. 3 in. overhang on each side. The longitudinal spacing is about 19 ft., except near expansion joints and over streets where other span lengths were necessary.

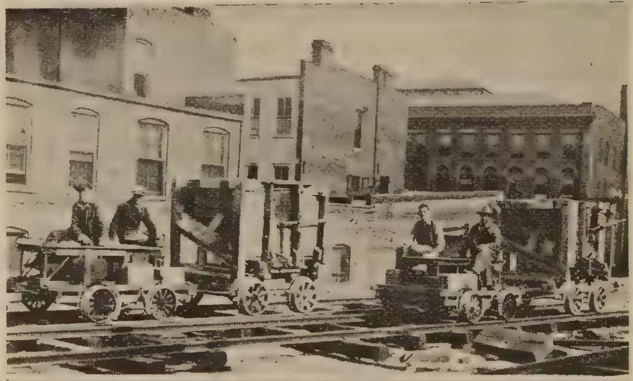
The columns were designed for E-65 loading on all tracks. The structure rests on caissons carried to bedrock, which is found from 10 to 30 ft. below street level. Circular columns were used throughout, except at expansion joints and street crossings, where rectangular columns were used. Steel forms were used for the circular columns and capitols and wood forms were used for the rectangular columns and capitols. All columns were reinforced with spiral reinforcing and vertical bars, the vertical bars extending up into the deck.

The excavation of the caissons material was handled direct into dump wagons, a rail laying machine being used to hoist it from the caissons into the wagons.

The caissons and columns were poured from a portable mixer, moving along as the work progressed. The slab was poured from a central mixing plant, which had also been used on other important work by the company. This plant consisted of two one-yard mixers, steam driven, one hoisting tower for each mixer and chutes across the temporary main tracks. The chutes depositing the concrete into hoppers from which it was loaded into 1-yd. dump cars which were hauled by gasoline section cars over standard-gauge track running up over the slab forms. The maximum haul was about 1,600 ft.

The structure is divided by 1-in. expansion joints into separate slabs of about 225 ft. length. Double columns





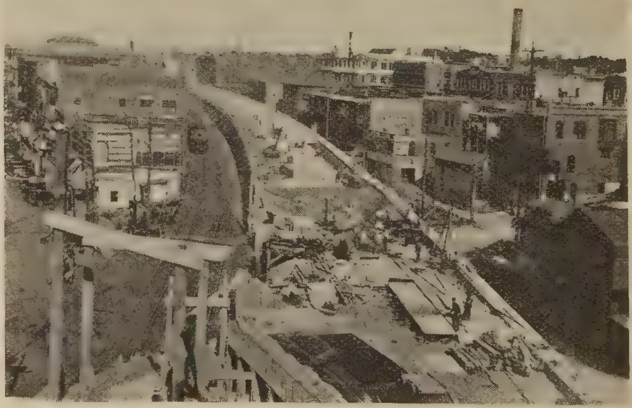
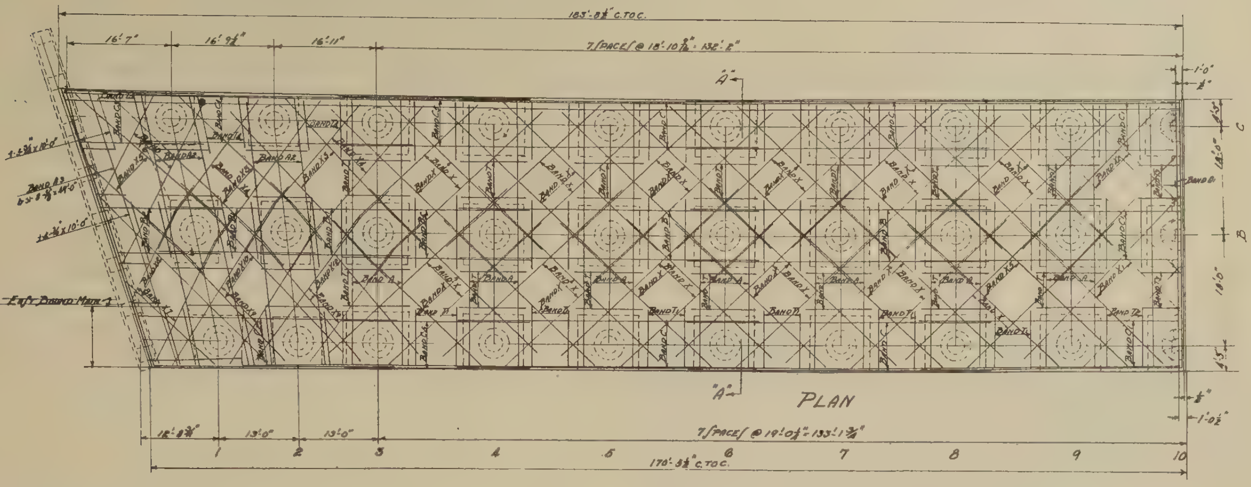
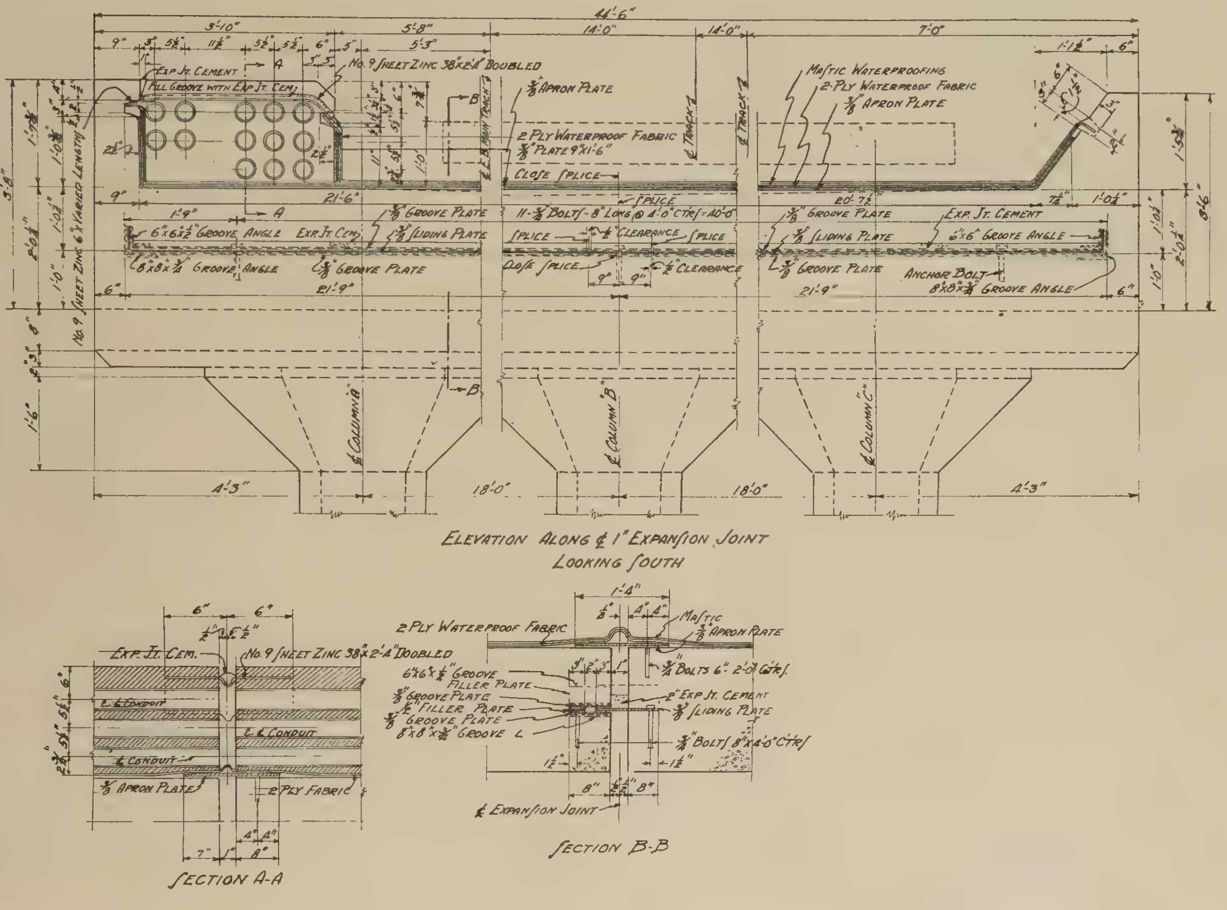


Fig. 1—Paneled Portion of Slab Along West Side of LaSalle St., Looking South from Main St.—Structure Complete Except Hand Rail

Fig. 2—Concrete Motor Trains with Fairmont Engines—Yard Hoppers Mounted on Rubble Cars—Part of Time Equipment Included a Second Yard Car of Lighter Construction

Fig. 3—Looking East or North from Broadway—View from Concrete Tower Above Broadway Subway—Waterproofing Just Started





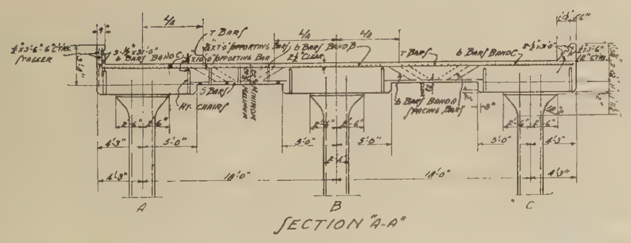


Fig. 4—Part Plan of Flat Slab Structure Carrying Track Elevation

Fig. 5—Elevation and Section, Showing Expansion Joint Details

Fig. 6—Section A-A Through Column Bent

are used at the expansion joints. Waterproofing of the expansion joints was accomplished by inserting half way up in the slab a steel expansion joint consisting of three plates riveted in the form of a "U" and set into one section of the slab with a plate extending into the "U" from the other section of the slab. Over this plate a pliable asphalt was used.

Telegraph and signal duct lines are provided in one of the parapets. Membrane waterproofing was placed under the duct lines and up the outer edge of the duct line, where a 9-in. thick parapet wall was constructed integral with the slab.

Advantages of Hydrated Lime in Paving Concrete

Discussion of a Paper Read by T. B. Shertzer Before
City Paving Conference

By Duff A. Abrams
Professor in Charge, Structural Materials Research Laboratory
Lewis Institute, Chicago

The paper[2] by Mr. Shertzer of the National Lime Association, contains many erroneous statements which should be corrected in the interests of sound engineering practice.

Mr. Shertzer states:

> Hydrated lime is the most efficient water-tightening medium available. The statement to the effect that it is the most efficient medium has been made by the United States Bureau of Standards as the result of an exhaustive series of tests in which all of the available media were experimented with.

The following paragraphs from the Summary of the Bureau of Standards Technologic Paper No. 3, on "Tests of Damp-Proofing and Waterproofing Compounds and Materials," by Wig and Bates, show that the conclusion of the Bureau of Standards is exactly reverse of that claimed by Mr. Shertzer:

> Portland cement mortar and concrete can be made practically water-tight or impermeable (as defined below) to any hydrostatic head up to 40 feet without the use of any of the so-called "integral" waterproofing materials; but in order to obtain such impermeable mortar or concrete, considerable care should be exercised in selecting good materials as aggregate and proportioning them in such a manner as to obtain a dense mixture. . . . .
>
> The addition of so-called "integral" water-proofing compounds will not compensate for lean mixtures, nor for poor materials, nor for poor workmanship in the fabrication of the concrete. Since in practice the inert integral compounds (acting simply as void filling material) are added in such small quantities, they have very little or no effect on the permeability of the concrete. If the same care be taken in making the concrete impermeable, without the addition of waterproofing materials, as is ordinarily taken when waterproofing materials are added, an impermeable concrete can be obtained.

In response to my inquiry, Mr. Bates wrote as follows:

> "Washington, D. C., August 12, 1922.
>
> My Dear Abrams:
>
> Replying to your letter of August 4, in regard to Mr. Shertzer's statements, I would state that I believe you are correct in assuming that he refers to Technologic Paper No. 3 of this Bureau. However, as a joint author of this paper, I may state that I do not believe that we secured any data presented in this paper which would give Mr. Shertzer any reason for making the statements referred to. Furthermore, I do not believe that we drew any conclusions of the nature which he cites. Consequently, I cannot understand how he has been able to make the statements that he does in this connection. The Chairman of the Committee C-2, American Society for Testing Materials, has brought this to my attention and I have informed him also, that as a joint author of this paper, I cannot understand how Mr. Shertzer has drawn the conclusions that he has from the data or summary, or any part of that particular paper.
>
> "I have no objection to your quoting any of the above.
>
> Very truly yours,
> (Signed) P. H. BATES."

The following suggests an act of legerdemain, which might be entitled, "Water, water, who has the water?"

> The property of absorbing water, for which it has no use chemically, being fully satisfied, reduces the free water content of the entire mass, since the water is restrained by the hydrated lime. When the excess water evaporates, it does not leave pores or cavities within the mass of the concrete, since it is present, largely, as envelopes of the particles of hydrated lime, instead as of globules or droplets.

It can be accepted as a fact that if there is an excess of mixing water in concrete, it will leave corresponding voids, which will in turn lower the load-carrying capacity of the concrete and greatly reduce its resistance to weather and other destructive agencies.

Our tests, which go with this subject fully, show that the absorption of concrete is not decreased by the addition of hydrated lime. The tests show that the evaporation of water from wet concrete is somewhat retarded by the higher percentages of hydrated lime. (See Fig. 13, Bulletin 8, Structural Material Research Laboratory, "Effect of Hydrated Lime and Other Powdered Admixtures in Concrete.")

The following statement refers to the effect of hydrated lime on the strength of concrete:

> Numerous tests have demonstrated that the compressive strength of concrete is little affected by the presence of hydrated lime, the majority show a slight increase, when the tests have been conducted under conditions approximating field conditions. With the exception of absorption and permeability, both of which are materially decreased, none of the other properties of concrete are affected to any great degree.

As a result of many thousand tests made in this Laboratory, we concluded that "In usual concrete mixers, each 1% of hydrated lime (in terms of the volume of cement) reduced the compressive strength 0.5%; 1% by weight reduced the strength 1.2% . . ." The tests were made 2 or 3 years ago, but we have found no reason to alter conclusions.

The effect of hydrated lime in concrete highways was clearly shown in the Bates Road test by the Illinois Division of Highways as reported in its official bulletins and summarized in the *Engineering News-Record,* August 10, 1922. This test was made on an actual road built in the field and tested by means of truck traffic. A 4-in. slab of 1-2-3½ concrete, using 7.5% hydrated lime, failed completely under the second traffic run (rear truck wheel load, 3500 lbs.), while the next slab of same composition, except no lime, showed no failures at this load, and gave much better results under subsequent loads.

A properly-made concrete needs no assistance that hydrated lime can give. One feature of modern practice which must be guarded against, is the tendency to use too much mixing water and too little curing water. The greatest enemy of concrete is too much mixing water. Hydrated lime simply exaggerates this difficulty, since additional water is required on account of its presence.

By T. B. Shertzer.

In his discussion, Mr. Abrams claims by direct charge and by inference, that I have deliberately falsified and misrepresented. He states in his opening paragraph, that my paper contained many erroneous statements which should be corrected in the interests of sound engineering practice. A careful reading of his discussion fails to disclose any evidence or data whereby the so-called erroneous statements are pointed out or corrected.

His quotation from the conclusions of Technologic Paper No. 3 of the U. S. Bureau of Standards, are entirely beside the point. No engineer or investigator will deny the fact that it is possible to make the richer mixes of concrete impermeable, using only cement and aggregate.

I am at a loss to understand the true significance of the reproduced letter from Mr. Bates, when on page 59

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[1] Held in Philadelphia, October, 1921

[2] As published by *Canadian Engineer*, January 3, 1922, p 111.

of Technologic Paper No. 3 of the United States Bureau of Standards is to be found the following:

> Compound 27b—This is the most efficient medium employed and resulted in an almost impermeable mortar, at the two-week test. Its value is probably due to its void-filling properties and the same results could be expected from any other finely ground inert material, such as sand, clay, etc.

Compound 27b was hydrated lime—see table on page 44.

No fault is to be found with the statement that finely ground sand, clay, etc. will be as effective as hydrated lime. When the cost of producing ground sand, clay, etc., of the same degree of fineness as hydrated lime is considered, the advantage of using hydrated lime is apparent.

On page 62 in discussing the effect of materials in the 1-6 mortar mixes we find

> The efficiency of 2% of inert hydrated dolomitic lime filler is apparently as great as that of any of the water-repelling compounds in this mortar. Compound No. 27b was the most effective waterproofing medium in this mortar.

On page 64—

> The value, for dampproofing purposes, of the addition of compounds to a 1—4 mortar mixture is evident from the result recorded in the table. It will be observed that all the mortars containing water repelling compounds were dampproof; also the mortar containing 10% of inert hydrated lime filler, but the mortar containing only 2% of the hydrated lime failed.

Carefully selected and partial quotations can be made to convey almost any desired impression when considered aside from the complete text. The following quotations are from the same "conclusions" as are the ones presented by Mr. Abrams.

> However, these tests should be interpreted with caution, as the evaporation may have been sufficient to care for the slight amount of moisture coming through the test pieces without indicating on the filter paper.
>
> The mortar used in these tests was, perhaps, too coarse and too absorptive for a fair test.
>
> Well graded sands, containing considerable graded fine material, are preferable for making impermeable concrete, but if such is not to be had, fine material in the form of hydrated lime, finely ground clay or an additional quantity of cement, will be found of value.

The comments on the quotation from my paper in connection with the statements as to the absorption of water by hydrated lime, are so far afield and forced, that they are grotesque.

In Bulletin No. 8 of the Lewis Institute, on page 69, we find in connection with the discussion of a series of tests, in which the water was kept constant:—

> The increase in strength, with the addition of hydrated lime in Group 3, is to be expected; the absorption of water by the lime thus producing a drier concrete as the quantity of lime was increased.

Mr. Abrams answers his own riddle—"Water, water, who has the water."

I see no reason for altering the next quotation from my paper and stand by the statement that the majority of tests conducted under conditions approximating field conditions, show a slight increase in strength, due to hydrated lime admixtures. The "conclusion" from the "20,000 specimen" test series (Reported in Bulletin No. 8 of the Lewis Institute) has been worn rather threadbare by constant repetition. This and other conclusions are fully discussed in the forthcoming Proceedings of the American Society for Testing Materials and no attempt will here be made to dissect it.

It is unfortunate that a more complete discussion of the Bates road tests were not given. The concrete was of a basic 1-2-3½ mix, with 7½% of hydrated lime used in Section 61A. This section is 100 ft. long and studies were made as to the effects on the ultimate strength of concrete mixed for varying periods, the easterly 33-1/3 ft. was mixed for 30 seconds, the next 33-1/3 ft. for 45 seconds and the westerly 33-1/3 ft. for a full minute. The slab was only 4 in. thick. The easterly section (mixed 30 seconds) failed under the second load increment, the middle section (mixed 45 seconds) failed under the third load increment, but the westerly section (full minute mix) stood up until the fifth increment of traffic as well, if not better, than any 4-in. section of the whole road. Doubtless Mr. Abrams only had the report on the easterly section called to his attention.

Breaking Up Walls of Reinforced Concrete Vault

Removing Reinforced Concrete With Paving Breakers

When it was found necessary recently to remove the side walls and top of a large venturi vault and a section of the west wall of the filter building of the Cleveland, O., filtration plant, it was found advantageous to use Ingersoll-Rand CC-25 paving breakers after this equipment had been given a brief trial.

The section of the west wall that was removed was 23 ft. long, 20 ft. deep and 24 in. thick. The wall, being of concrete, reinforced with ½ in. to ¾ in. rods, spaced on 8 in. centers, made a very solid formation which was difficult to remove.

The accompanying illustration shows the paving breaker at work on the side walls of the venturi vault. These walls are 12 in. thick, 51 ft. long and 10 ft. high. The reinforcing was carried out the same way as in the west wall of the filter building.

The paving breaker used is an automatic compressed air operated pick and chiselling machine. It is similar to a non-rotating hand-hammer rock drill. It is light and extremely simple and operated by one man when working downward. In this particular case, however, it was found advantageous to use two men on each machine.

Three days' time was required to demolish the west wall, and the side walls were removed in seven days. This work would have taken a number of men a much longer time if hand methods had been used, and would have been more expensive. The paving breakers not only broke up to concrete in pieces large enough to be handled by one man, but with the aid of a cutting chisel they also cut off the steel reinforcing side rods.

The work of removing the concrete was done by the Lake Erie Construction Co., Cleveland, O.

For the above information Concrete is indebted to the Ingersoll-Rand Co., 11 Broadway, New York City.

Road Builders' Convention

The American Road Builders' Association announces a program for its convention at the Congress Hotel, Chicago, January 16, 17, 18, and 19, which indicates a thorough consideration of all the broad road building problems covering design, construction, maintenance, traffic, and finance. The program is announced as follows:

Tuesday, January 16, 10 a. m.—President's address, Thomas J. Wasser, State Highway Engineer of New Jersey, President American Road Builders' Association. Greeting and inspiration, James H. MacDonald, treasurer American Road Builders' Association. "Continued Highway Expenditures Required to Meet Traffic Demands of the Future," Thomas H. MacDonald, Chief U. S. Bureau of Public Roads, Washington, D. C. "Progressive Construction of Highways"—(a) "Practice in North Carolina," C. M. Upham, State Highway Engineer, North Carolina; (b) "Practice in Iowa," C. Coykendall, Assistant Chief Engineer, Iowa Highway Commission. "The Obligation of the State Highway Department to Keep the Public 'Sold' on Highways," H. E. Hilts, Acting Chief Engineer Pennsylvania State Highway Department, Harrisburg, Pa.

Tuesday, January 16, 2:30 p. m.—"What Test Roads Results Have Taught Us"—(a) "Bates Test Road," Clifford Older, State Highway Engineer of Illinois, Springfield, Ill.; (b) "Pittsburgh Test Road," Lloyd Aldrich, Consulting Engineer, San Francisco, Cal.; (c) "Arlington Tests," A. T. Goldbeck, Engineer of Tests, Bureau of Public Roads, Washington, D. C. "Development of Apparatus for Field Testing of Roads," H. F. Clemmer, Testing Engineer, Division of Highways, Springfield, Ill. "Developments in the Use of Local Materials," Vernon M. Pierce, District Engineer, U. S. Bureau of Public Roads, Washington, D. C. "Designed Subgrade," C. M. Upham, State Highway Engineer, Raleigh, N. C.

Wednesday, January 17, 10 a. m.—"Haulage Methods in Highway Construction"—"Industrial Railways," A. J. Parrish, General Contractor, Paris, Ill.; "Heavy Truck Haulage," Charles H. Fry, Charles H. Fry Construction Co., Erie, Pa.; "Light Truck Haulage," A. E. Horst, Henry W. Horst Co., Rock Island, Ill. "How to Equip and Operate Local Gravel Pit to Produce Concrete Aggregate," H. E. Kuelling, Construction Engineer, Wisconsin Highway Commission, Madison, Wis. "How Much Time Is Lost in Delays in Highway Building?" H. K. Davis, Chief Inspector Iowa Highway Commission, Ames, Iowa. Discussion: B. H. Piepmeier, State Highway Engineer of Missouri, Jefferson City. "What Road Building Work Can Be Done in Winter?" John H. Mullen, Chief Engineer Minnesota Highway Department, St. Paul, Minn.

Thursday, January 18, 10 a. m.—"Organization of Intensive Maintenance on a State Highway System in Eighteen Months," Frank Page, Chairman North Carolina State Highway Commission, Raleigh, N. C. "Four Years' Experience with Patrol Maintenance in Wisconsin," J. T. Donaghey, Maintenance Engineer, Wisconsin Highway Commission, Madison, Wis. "Gravel Road Maintenance Practice in Michigan," L. H. Nielsen, Deputy State Highway Commissioner of Michigan, Lansing, Mich. "Blade Grader and Road Drag Earth-Road Maintenance in Iowa," W. H. Root, Maintenance Engineer Iowa State Highway Commission, Ames, Iowa. "Salvaging and Maintenance Macadam Roads," W. A. Van Duzer, Assistant Maintenance Engineer, Pennsylvania Highway Commission, Harrisburg, Pa. Discussion: A. W. Muir, Superintendent of Maintenance, New Jersey Highway Commission, Trenton, N. J.

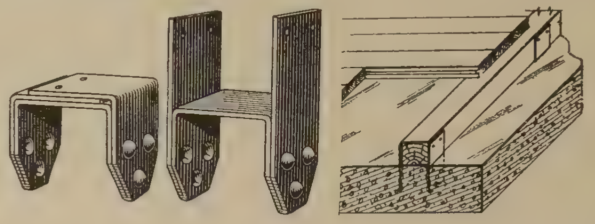
Thursday, January 18, 2:30 p. m.—"Tourist Traffic as a Factor in Highway Development (Illustrated)," A. R. Hirst, State Highway Engineer of Wisconsin, Madison, Wis. "Changes Needed in Motor Vehicle Legislation and License Fees," J. N. Mackall, Commissioner of Roads, Baltimore, Md. Discussion: Leon C. Herrick, Director of Highways and Public Works, Columbus, Ohio; Harry Meixell, Jr., New York, National Automobile Chamber of Commerce. Election of Officers. Business Meeting.

Friday, January 19, 10 a. m.—"Have Large Expenditures Changed the Public Attitude Toward Highway Development," S. E. Bradt, former Superintendent of Highways of Illinois. "Cooperation Between State and County Highway Department," L. C. Herrick, Director of Highways and Public Works, Columbus, Ohio. "How Individual Organizations Can Fit Their Work Into the Broad Highway Research Program," W. K. Hatt, Director Highway Research Committee, National Research Council, Washington, D. C.

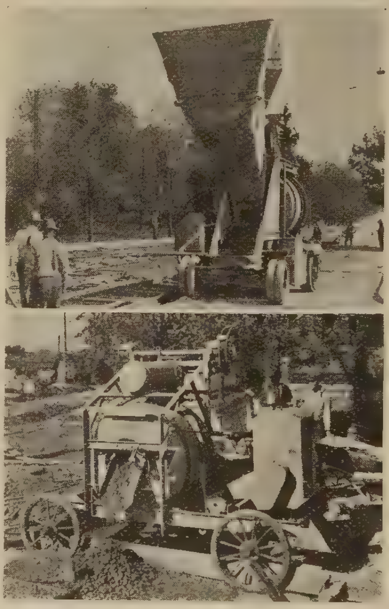
The road show in which there is always tremendous interest, will be held at the Coliseum.

New Floor Clip for Screeds

The illustration shows the Bulldog floor clip and how it is used in holding floor strips for the application of wood floor over concrete, entirely eliminating cinder concrete fill. When the concrete floor is scraped level, the floor clip, with the top folded down, as shown at the extreme left, is shoved into the fresh concrete on 16-in. centers, using a plank for straight edge. When the concrete is hard the prongs are bent up. The two nail holes on each side are to fasten the floor strips between them, leveling the strips with shingle wedges and filling with mortar. The device is made by The Bull Dog Floor Clip Co., Winterset, Iowa.



A New Rubber-Tired Mixer



Mixers Equipped with Rubber Tires for Fast Trailer Service

There is a growing demand for concrete mixers of the smaller type, especially the one-bag size, equipped with rubber tires instead of the standard steel wheels commonly used. This is especially true on city work where the mixers must frequently be hauled for considerable distances over hard surfaced roads—often brick or stone—across street car tracks, railroad tracks and other obstructions which jar the mixers severely. Rubber tires cause fewer shocks to the mixer and in addition are easier on the pavement.

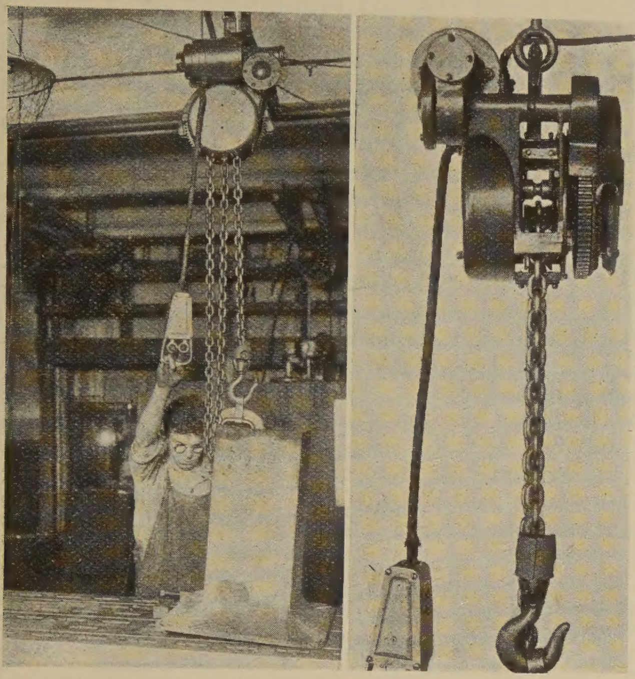
The mixer shown in the illustration is one of seven Rex mixers (Chain Belt Co., Milwaukee, Wis.) operated by the city of Milwaukee, while the Rex paver shown is operated by the Milwaukee Electric Railway & Light Co. Both users are equipping a great deal of their construction machinery with rubber tires, and find that it reduces the wear and tear considerably. The Milwaukee Electric Railway & Light Co. recently moved its paver from one part of the city to another with a hammer lying on the boom for the entire distance.

Boss Big One-Bagger—The American Cement Machine Co., Inc., Keokuk, Ia., a new folder announcing the Highway special mixer running on cord tires for rapid transit, trailer fashion, without damage from rattling and jarring, with illustrations and descriptions also of other Boss special purpose types.

Electric Motor Block

The illustrations show an electrically operated material-handling device, known as the Motorbloc, placed on the market by the Motorbloc Corporation of Summerdale, Philadelphia. It was developed to serve the operations lying between the well-defined field of the standard hand chain hoist and that of the traveling electric hoist, with the substantial overhead and electrical installation which its heavy duty requires.

The Motorbloc is a rugged and readily portable hoist, which can be installed without engineering preliminaries in any location where electric current is available. It is put in service with the facility of an electric drill or vacuum cleaner, and the self-contained pendant controller permits convenient operation as soon as the corn has been plugged into the nearest electric circuit. The Motorbloc consists of a standardized chain hoist of steel construction, electrified by the application of a specially designed heavy-duty motor, with capacities ranging from ¼ to 10 tons, proportioned to stand up under the severe overloads and abuse to which portable apparatus of this character is subjected by common labor, generally unfamiliar with the handling of power machinery.



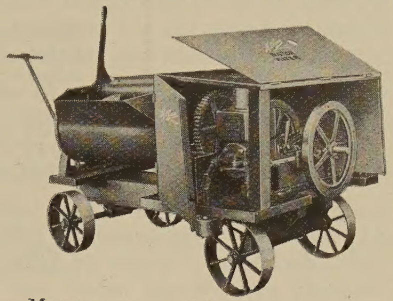
Motorbloc Is Between a Hand Chain Hoist and a Traveling Electric Hoist

The pictures show how the device can be hooked up in any part of a factory, garage or warehouse, for speeding up the handling of all sorts of materials without fatiguing labor or elaborate preparations. For occasional use at points where electric current is not available, or in the event of the temporary failure of electric power, the hand chain can be quickly applied and the hoist operated as an ordinary block. The self-contained electrifying unit can be readily applied to standard chain hoists already in service.

Acting upon the suggestion of Secretary of Commerce Hoover, who is interested in cutting the waste that results from excess of materials and principally those of production, the Associated Metal Lath Manufacturers, Inc., announce that they are preparing to reduce the number of varieties in the long list of metal lath products. A preliminary meeting to this end was held with William A. Durgin, of the Department of Commerce, early in October and a formal meeting arranged for early in December, when representatives of the Associated Metal Lath Manufacturers, architects, plasterers, lathers, contractors, and dealers will be invited to join in the conference. W. B. Turner of the General Fireproofing Co., Youngstown, is chairman of the Industry Committee on this subject, and Wharton Clay, Commissioner of the Associated Metal Lath Manufacturers is secretary.

Mixer Has Reserve Batch Hopper

The Atlas small batch mixer, shown in the accompanying illustration, has a reserve hopper which is filled with the materials for one batch, while another batch is mixing. This mixer was designed especially by the Atlas Engineering Co., Milwaukee, to meet a demand for a light and well built mixer suitable for many different kinds of work.



Atlas Batch Mixer

Organizations

American Concrete Institute; Secretary, Harvey Whipple, 1807 East Grand Boulevard, Detroit. Convention, Cincinnati, Ohio, January 22-25, 1923.

American Concrete Pipe Association, M. W. Loving, Secretary, 111 West Washington St., Chicago.
Convention January 18-20, Sherman Hotel, Chicago, Ill.

American Engineering Standards Comm., Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth Street, New York City, December 14, 1922, 29 W. Thirty-ninth Street, New York City.

Asso. General Contractors of America, G. W. Buchholz, Secretary, 1038 Munsey Bldg., Washington, D. C. Convention probably January 30 to February 2, 1923. Los Angeles, Cal.

Associated Metal Lath Manufacturers, 123 W. Madison St., Chicago; Wharton Clay, Commissioner.

Portland Cement Association; William M. Kinney, General Manager, 111 West Washington Street, Chicago.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Mid-West Concrete Products Assn., Frank Whipperman, Secretary-Treasurer, 3045 Fowler Bldg., Omaha, Neb.

National Crushed Stone Assn.; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Assn.; Lawrence Veiller, Secretary and Director, 105 East 22nd St., N. Y. C.

The National Lime Association; Mather Bldg., Washington, D. C.

National Sand and Gravel Producers' Association; T. R. Borrows, Acting Secretary, 903 Munsey Bldg., Washington, D. C.

The National Concrete Stave Silo Asociation; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.
Convention December 5-7, Hotel Sherman, Chicago, Ill.

How many of these Questions can YOU answer?

Why do some of the biggest and most successful contractors place their concrete from buggies rather than through chutes? What are the relative advantages of the two methods of placing?

Why does the average contractor use a **batch** in preference to a **continuous** mixer?

What methods have been found successful in making concrete floor finish set up quickly in cold weather?

How can laboratory tests which are now being made with regard to consistency of concrete be put into practical use?

Is the use of pre-mixed aggregate now on the market and in common use in some cities to be encouraged or discouraged for concrete structures of small sections such as occur in building work? Is the use of pre-mixed aggregates economical? What are their other advantages and disadvantages?

Is it better to install cement fill and finish before or after plastering is done?

Does the economy which the use of slag aggregate entails warrant its use in reinforced concrete buildings?

How may cinders be used most successfully for roof-fill to avoid expansion and displacement of parapet walls?

Is the value of integral waterproofings purely psychological in its effect on the contractor?

What are the causes of the corrosion of steel and the disintegration of concrete under special conditions of exposure? What are the remedies?

How can a satisfactory surface finish be given to concrete industrial buildings?

How can the costs involved in the manufacture of concrete block and concrete structural tile be analyzed?

Under what conditions is it more economical in lowering the cost of concrete block and building tile to make special mixtures of aggregates rather than use a natural supply?

Is it more economical to operate a products plant twelve months in the year, or eight months in the year?

(Actual figures will be presented.)

How can costs be cut in concrete products manufacture by selection and combination of aggregates?

There will be a special demonstration and discussion conducted by Prof. Duff A. Abrams of the Structural Materials Research Laboratory, Chicago.

When is it safe to use impure water in mixing concrete? For years all specifications have insisted upon pure water. Some very important discoveries (tests made by Prof. A. Abrams) have been made—and it is found that comparatively few of about half a hundred impure water samples examined actually gave unsatisfactory results when used as gauging water in concrete.

What changes must be made in our road-building standards to meet present-day traffic conditions?

What are the possibilities for standardization of quality and united action in the development of concrete roof tile?

Will concrete blocks resist fire exposure to such an extent as to warrant a better insurance rate?

For full information about the convention, address

HARVEY WHIPPLE, Secy.,
American Concrete Institute,
1807 East Grand Blvd.,
Detroit, Mich.

Come to Cincinnati and get the answers!

Rarely if ever before has a program been developed to produce more practical, on-the-job dollars and cents information than the offering to contractors, concrete products manufacturers and engineers, at the Convention of the American Concrete Institute at Cincinnati (Sinton Hotel) January 22, 23, 24, 25, 1923. Whether a member of the Institute or not, you are welcome to attend.

He Said—

"Folks Won't Pay Any More For White Blocks Than For Gray"

—But They Did!

HE manufactures concrete blocks in a busy, prosperous community—just as you do. He is trying his level best to turn out good, uniform, dependable blocks—just as you are—and has gradually built up a good reputation for himself and his product.

But he *didn't* believe folks who bought concrete blocks for porch columns, pillars, aboveground foundation work, etc., cared anything about the color. "Blocks are blocks to *my* customers," he said.

So, one day the Medusa man went down to his place and painted the face of one of his blocks a pure, shining white with Medusa Cement Paint. Then he painted another a clear, pretty red and another a bright green—you know Medusa Cement Paint comes in several pleasing colors beside white. Then the Medusa man put these blocks out in front, set at a good angle to attract attention. And at the end he put a plain, common gray block just as it came out of the mold!

Well, pretty soon along came a building contractor with a bill of stuff for an estimate. "Gee!" he said, "where'd you get 'em? Just what I need for the foundations and porch columns of those bungalows we're putting up over in Brannon's Allotment. How much?"

You see, he thought they were some special composition! When he found they were just common blocks with two coats of Medusa Cement Paint, he was tickled all over; and you should have seen him grin when he found what a trifle the paint added to the cost of the job!

Did he buy? You bet he did, right then and there! Our block-manufacturer friend not only sold the Paint at a profit, but he cut competition clear out—because the contractor had planned to go to another block maker and get *his* price, too!

In about half an hour, an Architect drove by, and the "rainbow" stopped *him.* Happened that he had just gotten the commission to design a church, and while he had already decided to use Medusa White Cement cast-stone trim around windows, doors, and cornice, he was trying to figure some way to cut costs on the ground course and water-table.

Those pure white blocks gave him an idea; so he stopped his car, came in, asked a lot of questions, and drove away again.

A couple of weeks later, the concrete man found that his blocks had been specified; and when the job was let, the contractor came straight to him with the order.

Along that same afternoon, a woman came in with a complaint. That is, she came *intending* to make a complaint, but when she saw those blocks, she changed her mind. She had gotten some fern vases the year before (this concrete man makes garden furniture, too) and she was "peeved" because they had discolored a little in the weather.

But those clean, fresh-looking blocks out front gave her a new idea; so instead of reading our friend a lecture, she asked some questions and then hired him to send a man up and paint her vases with Medusa Cement Paint. A little later she ordered some new stuff, also painted white, and before the season was over, seven of her friends had ordered pieces for *their* gardens.

That was one busy season for Mr. Cement Block Man—and for the dealer who sold him his Medusa Cement, Medusa Waterproofing, and Medusa Cement Paint. But when he checked up at the end, he found he was away ahead of any year he had ever put in before; and better still, he found he had all the good trade of his neighborhood coming right to his door—some of it past the plants of other block-makers whom he used to consider competitors!

* * *

Medusa Cement Paint comes in dry powder—white and five pleasing colors—ready to use when mixed with water. Brush it on like any other paint. Two coats will give concrete a handsome, lasting finish, impervious to dampness; will beautify new concrete or freshen and renew old jobs.

It contains no oil whatever and will bond perfectly on any surface of cement, stone or brick.

You can finish your work in Medusa Cement Paint as you produce it, or furnish the Paint right along with the blocks to be applied after construction.

In any case, keep a few blocks finished in white and colors, out on display all the time. We'll gladly send sample for you to try. What color?

The Sandusky Cement Company, Department C. P., Cleveland, Ohio.

Trade Publications

Standard Specifications for *Floor Hardening and Dust Proofing by the Acid Method,* for *Waterproofing Concrete by the Integral Method,* for *Hardening and Dust Proofing by the Oil Method,* for *Rainproofing and Moisture Proofing by Colorless Application, Oil Proofing for Concrete Tanks by the Enamel Method,* are issued in a series by the Gardner-Barada Chemical Co., through the National Concrete Specialties Co., 457 Peoples Gas Bldg., Chicago. These specifications give directions and general information in regard to Gar Kem products, Crystal Hardener, Integral Waterproofing, Concrete Dressing, Colorless Rainproofing, and Oil Proof Enamel.

Spacer Chairs and Clips for Mesh Reinforcement, Spacer Clips for Column and Beam Forms, Leonard Column Clamps, Form Spreaders and Bar Chairs for Concrete Walls are the subjects of folders issued by the National Concrete Specialties Co., 457 Peoples Gas Building, Chicago. These illustrate and describe the use of important items of equipment in reinforced concrete building construction in the placing and holding of reinforcing and the clamp for rectangular, hexagonal or circular concrete column forms. The clamp consists of a steel band, which is drawn up tight and locked to fit the particular column banded.

Collings Adjustable or Slotted Concrete Insert, made by the Kohler Die & Specialty Co., DeKalb, Ill., and sold through the National Concrete Specialties Co., 457 Peoples Gas Bldg., Chicago, Ill. The bulletin illustrates and describes several types of inserts, slotted and threaded for use in reinforced concrete building construction.

Concreting in Zero Weather with Aeroil Kerosene Flame Heaters—Aeroil Burner Co., Inc., 266 Hudson Ave., Union Hill, N. J. The equipment described and illustrated in the bulletin is made in two sizes, the smaller for concrete mixers up to 10 cu. ft. capacity, the larger for mixers from 10 to 21 cu. ft. capacity. They are equipped with 15 and 20 gal. oil pressure tanks, 12 ft. of oil hose, and flame distributor with clamps to be attached to mixer. The manufacturers claim that these heaters on mixers give a concrete of a temperature of 70° to 90° F. in zero weather, and that only in the most extreme weather is it necessary to slow up the mixer production.

The Anchor Stripper—Anchor Concrete Machinery Co., Columbus, Ohio. For making plain block, the stripper type of machine has long been recognized as a piece of dependable equipment. The unit is made and "stripped out" in that position—cores vertical—which permits the use of a mix of as near correct consistency as is possible. The Anchor machine, for hand work or with Anchor power tamper, is in three sizes, 16, 20 and 24 in.; 8 in., 10 in., or 12 in. thick block may, with proper cores, be made on any of the machines.

Debay Concrete Machinery—Debay Research & Mfg. Co., Springdale, Pa., 24 pages, 8¼ by 10½ in., with a double page size insert, assembled in a loose-leaf binder of processed leather in a handsome brown. It is a catalog of unusual distinction in the concrete block machinery field, and describes and illustrates in detail the use of Debay automatic machines in the production of block, brick, paving slabs, etc. The insert is a suggested ground plan for a block and brick plant occupying an acre of ground.

Koehring Crane-Excavator No. 2—Koehring Co., Milwaukee, Wis., 4 page folder in three colors, 10½ by 7½ in., describing and illustrating the Crane-Excavator No. 2. This folder tells what kind of work this equipment is best adapted for, its special features, and gives specifications for the machine.

Koehring Crane Excavator No. 3—Koehring Co., Milwaukee, Wis., 4 page folder in two colors, 10½ by 7½ in., describing and illustrating the Crane-Excavator No. 3. This folder tells how it can be changed from a drag-line to a clam-shell by shifting clutch, and how the boom clam-shell bucket can be in or out as often as necessary. It has a 4-cylinder 100 h. p. gasoline engine, and a 40-ft. radius the crane handles a one and one-half yard bucket. At a radius of 12 ft. it has a capacity of 20 tons. Specifications are given.

Colormix-Concrete Floor Hardener, Waterproofer and Dustproofer, in Colors—The Master Builders Co., Cleveland, Ohio, 11x7½; 11 pp. and cover, describing and illustrating Colormix, a satisfactory concrete colored floor for use in sun parlors, club rooms, laundries, halls of school buildings, offices, hospitals, theatre lobbies, restaurants, display rooms and so forth. Colormix dyes the gauging water, but it is more than a dye; it is also a hardener and waterproofer, it is claimed by its manufacturers.

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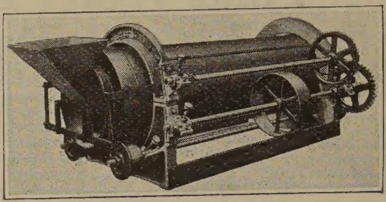

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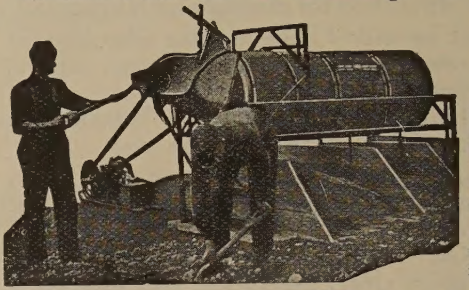

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